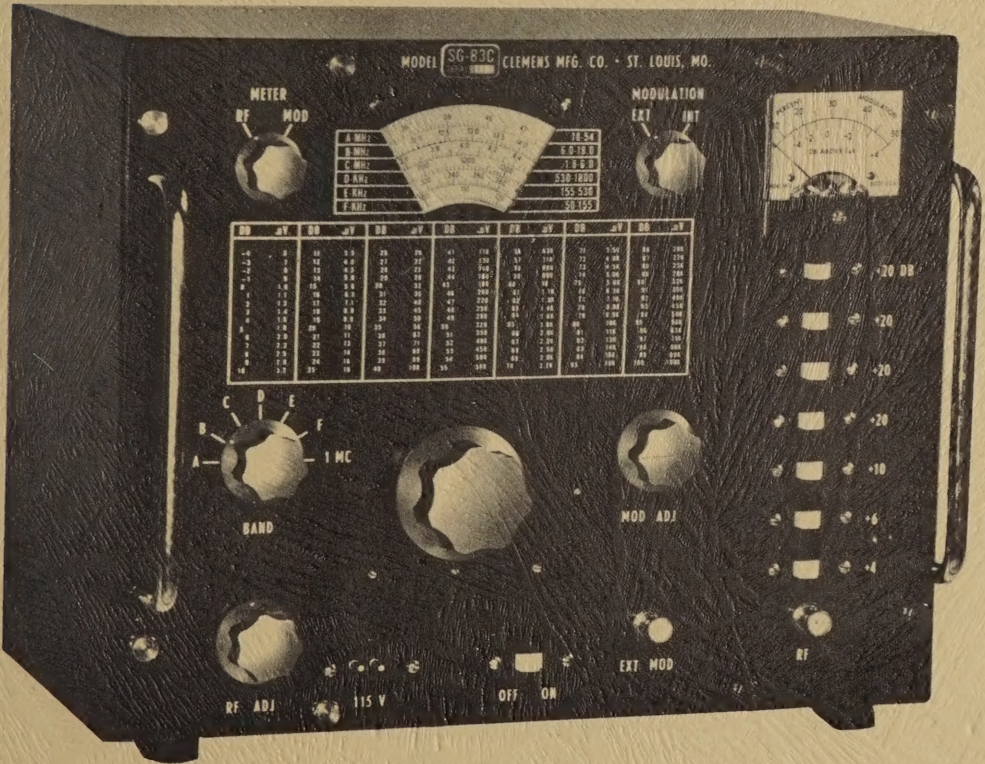
INSTRUCTIONS
for
MODEL SG-83C
Standard Signal Generator



CLEMENS MANUFACTURING COMPANY

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St. Louis, Missouri 63122
U.S.A.
Telephone: (314) 961-7228

WARRANTY

Repair or replacement of any defective part within ninety days after purchase will be made provided the unit is delivered with transportation charges prepaid to the factory and provided the unit has not been subjected to misuse. This warranty is in lieu of all other warranties expressed or implied.

MULTIPLIER PREFIXES

Prefix	Abbreviation*	Multiplier
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	u	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

**Although the abbreviations shown are recommended, almost all technical publications deviate to use upper or lower case letters for consistency in style or to conform to common usage.*

CM

CLEMENS MANUFACTURING COMPANY

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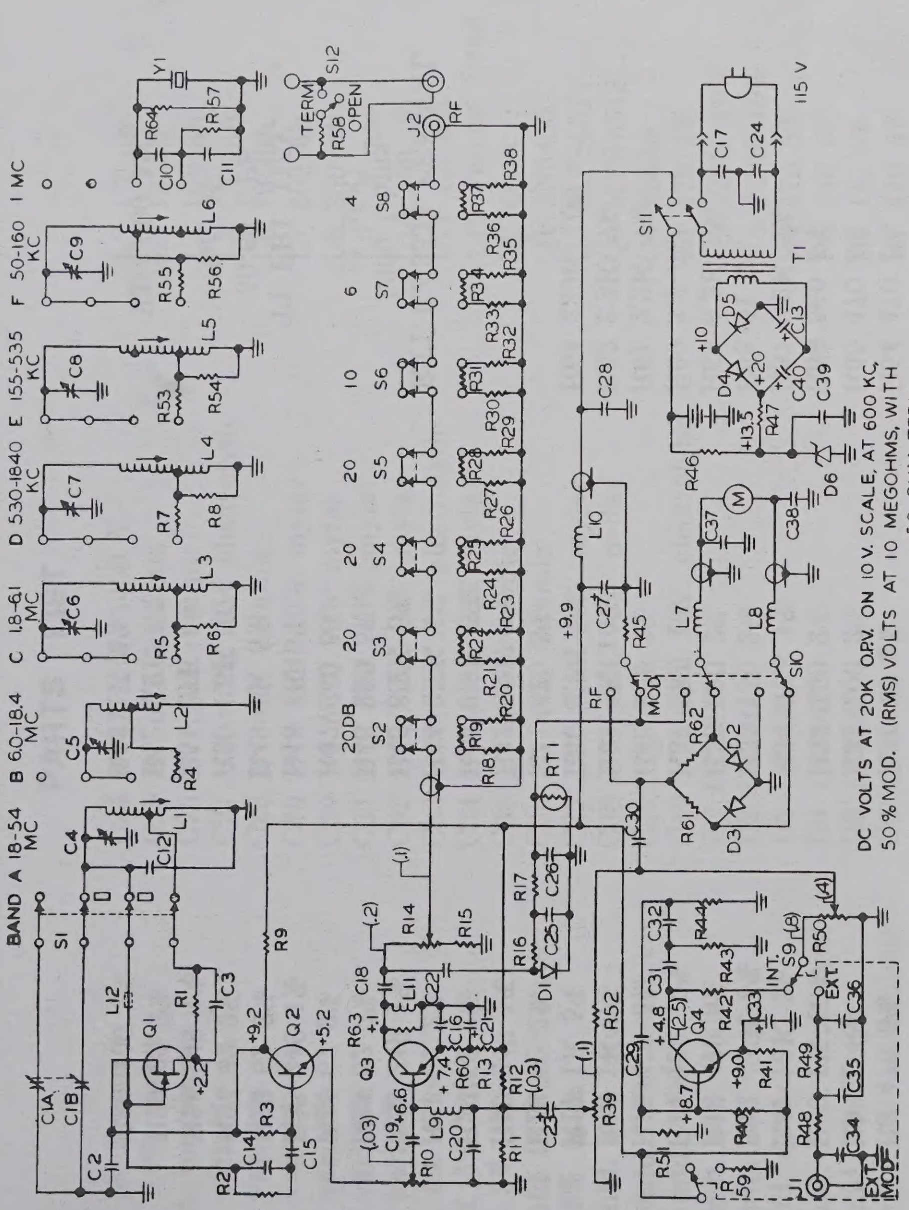
ORIG



DC VOLTS AT 20K O.P.V. ON 10 V. SCALE, AT 600 KC, 50% MOD. (RMS) VOLTS AT 10 MEGOHMS, WITH 50 OHM TERM.

Figure 7 Model SG-83C Schematic Diagram

SPECIFICATIONS

Frequency Ranges:	Band A:	18 — 54 Mhz
	Band B:	6.0 — 18.4 Mhz
	Band C:	1.8 — 6.1 Mhz
	Band D:	530 — 1840 Khz
	Band E:	155 — 530 Khz
	Band F:	50 — 155 Khz

Calibration: Frequency is indicated to an accuracy of 1% or better.

Output: 0.6 to 160,000 microvolts across a 50 ohm load in 1 db steps. Output is factory adjusted to 100,000 microvolts at 600 Khz. The output meter and switch attenuators are accurate to within one db of the calibrated output at any other setting throughout the frequency range of the instrument. Leakage fields are equivalent to less than 0.1 microvolt at the output terminals.

Modulation: Amplitude modulation is variable from zero to 50%. The percent modulation is indicated on the panel meter to an accuracy of ± 10% for carrier frequencies up to 30 Mhz. Internal modulation is 400 Hz ± 5% with less than 10% distortion. Input impedance at the external modulation jack is 2500 ohms at 1000 Hz. An input of 1.5 volts rms is required for 50% modulation at maximum setting of the modulation level control. Modulation is flat within 1 db from 100 Hz to 5000 Hz and within 3 db from 50 Hz to 10,000 Hz. Incidental frequency modulation is negligible below 30 Mhz and less than .05% at 50 Mhz.

Crystal Calibrator: In the seventh bandswitch position, the r-f oscillator is crystal controlled at 1 Mhz. Harmonics are usable to 30 Mhz or higher. Crystal frequency accuracy is better than .005%.

Power Supply: Operation for 40 hours, or approximately 4 months in average intermittent use of 1/2 hour per day, from

NEDA 1600 9 volt transistor battery (not supplied). Alternate operation from 115 volts, 50-60 Hz. Power consumption 1 watt.

Size: 10-1/2'' high, 12-1/2'' wide, 7-1/2'' deep. Shipping weight 19 pounds. Supplied with detachable line cord, four foot output cable, heavy vinyl dust cover, and two copies of the Instruction Manual.

PRICE and DELIVERY

The SG-83C Standard Signal Generator, with output and power cables, and two copies of the Instruction Manual . . . $295.00 f.o.b. St. Louis. Immediate shipment from stock.

R8 470 5%
R9 51 5%
R10 1K 10%
R11 10K 5%
R12 4.7K 5%
R13 470 5%
R14 100 10%
R15 470 5%
R16 1K 5%
R17 1K 5%
R18 62 2%
R19 249 1%
R20 62 2%
R21 62 2%
R22 249 1%
R23 62 2%
R24 62 2%
R25 249 1%
R26 62 2%
R27 62 2%
R28 249 1%
R29 62 2%
R30 100 2%

R31 75 2%
R32 100 2%
R33 150 2%
R34 37.4 1%
R35 150 2%
R36 220 2%
R37 23.7 1%
R38 220 2%
R39 1K 10%
R40 2.7K 5%
R41 470 5%
R42 2.2K 5%
R43 3.3K 5%
R44 2.7K 5%
R45 8.2K 5%
R46 220 5%
R47 240 5%
R48 1K 5%
R49 1K 5%
R50 1.5K 10%
R51 27K 5%
R52 2.2K 5%
R53 1K 5%

R54 470 5%
R55 470 5%
R56 560 5%
R57 2.2K 5%
R58 51 2%
R59 6.2K 5%
R60 3.3 5%
R61 2.2K 5%
R62 2.2K 5%
R64 220K 10%

RT1 KA35J3 FENWAL
5000 Ohms
at 25°C

T1 PRI. 115V.
50-60 CPS
Sec. 6V.

Y1 1.000 MC.

PARTS LIST

C1 10-272 pf. 2 gang
C2 .1 mfd. 10% mylar
C3 .01 mfd. ceramic
C4 1-8 pf. variable
C5 1-8 pf. variable
C6 1-8 pf. variable
C7 1-8 pf. variable
C8 1-8 pf. variable
C9 1-8 pf. variable
C10 15 pf. 5% mica
C11 100 pf. 5% mica
C12 15 pf. 5% mica
C13 100 mfd 16V electrolytic
C14 2 pf. 5% mica
C15 .001 mfd. 10% mylar
C16 .0047 mfd. 20% ceramic
C17 .0047 mfd. 1400V.
C18 .047 mfd. 10% mylar
C19 .047 mfd. 10% mylar
C20 .01 mfd. ceramic
C21 100 mfd. 16V. electrolytic
C22 .047 mfd. 10% mylar
C23 100 mfd. 16V. electrolytic
C24 .0047 mfd. 1400 V.
C25 .01 mfd. ceramic
C26 .01 mfd. ceramic
C27 100 mfd. 16V. electrolytic
C28 .01 mfd. ceramic
C29 .047 mfd. 10% mylar
C30 1.0 mfd. 10% mylar
C31 .047 mfd. 10% mylar
C32 .047 mfd. 10% mylar
C33 100 mfd. 16V electrolytic
C34 .001 mfd. 10% mylar
C35 .01 mfd. ceramic
C36 .01 mfd. ceramic
C37 .001 mfd. 10% mylar
C38 .001 mfd. 10% mylar
C39 100 mfd.
C40 100 mfd. 16V. electrolytic
D1 HD1811
D2 1N34A
D3 1N34A
D4 1N2482
D5 1N2482
D6 1N964B
Ll .17 uh
L2 1.7 uh
L3 13 uh
L4 160 uh
L5 1.7 mh
L6 19 mh
L7 250 uh
L8 250 uh
L9 1.5 mh
L10 250 uh
L11 1.5 mh
L12 Ferrite Bead
M 50 uA
Q1 2N5485
Q2 MPS6514
Q3 MPS6518
Q4 2N508
R1 470 5%
R2 220K 10%
R3 100K 10%
R4 470 5%
R5 240 5%
R6 1K 5%
R7 470 5%

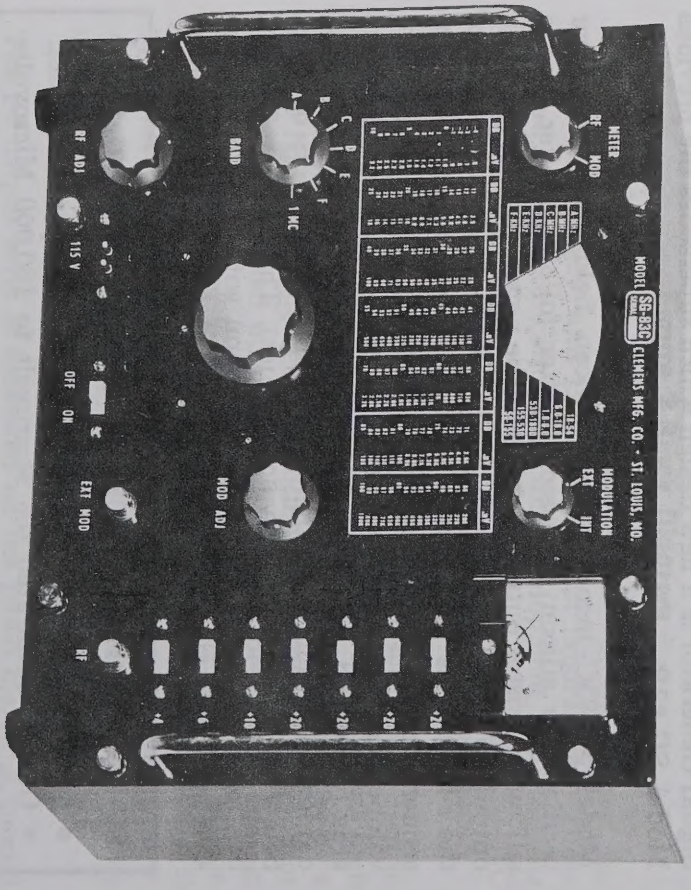


Figure 1 Model SG-83C
Standard Signal Generator

STANDARD SIGNAL GENERATOR
MODEL SG-83C
DESCRIPTION

The first all solid-state Standard Signal Generator, with output accurately calibrated in microvolts, was the Model SG-83 introduced by Clemens Manufacturing in 1962 and now in use throughout the world. This model was followed by improved designs, the Model SG-83A, introduced in 1964, and the Model SG-83B introduced in 1966. The Model SG-83C Standard Signal Generator is a new design which supersedes the previous Model SG-83B.

Model SG-83C incorporates a silicon field effect transistor oscillator, a silicon transistor emitter follower buffer, and a silicon transistor output amplifier. The new design produces an output r-f signal with much purer waveform. No distortion of the r-f signal is visible on a wideband oscilloscope. As a consequence of the low distortion r-f waveform, the modulation envelope has excellent symmetry. High order harmonics are greatly reduced. The second harmonic is 20 db below the fundamental output, and higher harmonics are 40 db or more below the fundamental (typical values). The low cost SG-83C has many desirable features in common with the most expensive standard signal generators. Standard signal generators

SG-83C PERFORMANCE FEATURES

- 50 Khz to 54 Mhz Coverage, 1% Frequency Calibration
- Output Calibrated 0.6 Microvolt to 160,000 Microvolts (.16 volt)
- 1 Mhz Crystal Operation
- Per Cent Modulation Variable 0 to 50% (Indicated on Meter)
- External Modulation Connector
- Operates from Internal Battery or from 115 Volts 50-60 Hz
- BNC Connectors

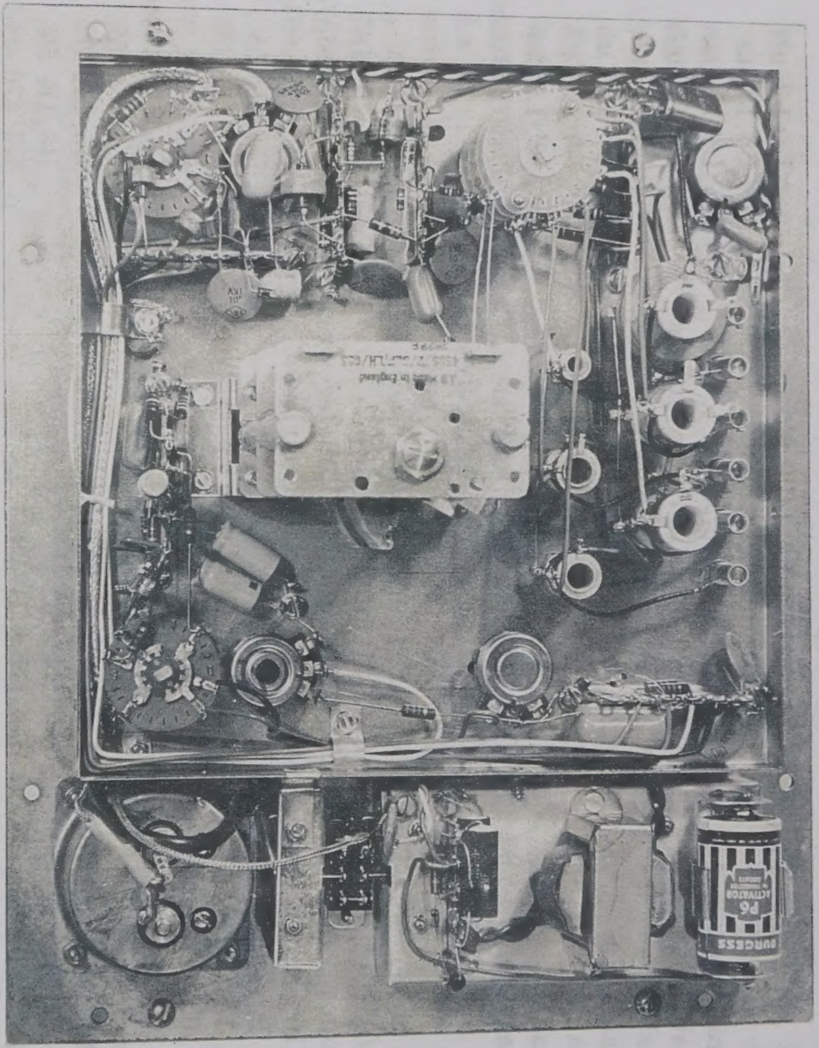


Figure 6 Interior View With Shield Removed

higher capacity may be preferred. It is also possible to destroy the output transistor if a transceiver under test is accidentally turned to transmit while connected to the SG-83C. The switch attenuator can withstand the steady application of up to 4 volts D.C. or rms without damage.

Field replacement of transistors is not difficult and will not invalidate the microvolt calibration of the SG-83C. It is not necessary to return the generator to the factory. The shielded switch attenuator need not be disturbed. Only the shield over the generator assembly is removed, by removal of sixteen screws.

If the audio oscillator transistor, Q4 (type 2N508) is damaged, it can be replaced without affecting the modulation frequency, per cent, or waveform.

If the r-f output transistor, Q3 (type MPS6518) is damaged, it can be replaced *without affecting the microvolt calibration in any way.* The per cent modulation will require recalibration with an oscilloscope, as described above.

The oscillator transistor, Q1, (type 2N5485) can be replaced also *without affecting the microvolt calibration.* Replacement may cause a slight change in the frequency calibration, although usually the change will not exceed the 1% calibration tolerance. If the frequency dial calibration error is excessive after oscillator tranistor replacement, the dial may be recalibrated with a frequency meter as described above.

The emitter follower transistor, Q2 (type MPS6514) may also be replaced without effect on either the frequency, microvolt, or modulation calibration.

Correct D.C. voltages are shown on the schematic diagram at a number of circuit points as an aid to troubleshooting. All D.C. voltages under 10 volts are read on the 10 volt scale of a 20,000 ohms per volt meter. R-F and audio frequency voltages are also shown in parentheses. These are read with an A.C. meter such as the Hewlett Packard 400 or Eico 250.

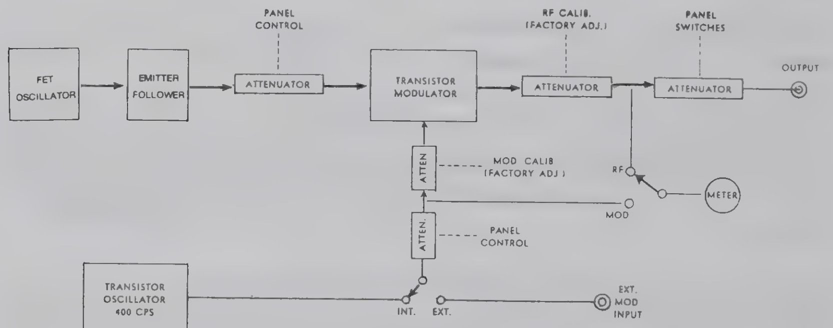


Figure 2 Block Diagram

from Clemens Manufacturing are in use in the largest industrial, university, and U.S. Government laboratories. Those engaged in communications circuit development will find the SG-83C indispensable. The low cost and stability of the SG-83C also make it ideal for production line alignment stations.

A silicon, N-Channel, field effect transistor oscillator is used in the SG-83C. A ferrite bead in the oscillator circuit prevents high frequency parasitic oscillations. The oscillator is followed by a silicon NPN transistor emitter follower to buffer the oscillator from the modulated output amplifier as a precaution against frequency modulation. Following the buffer stage is a silicon PNP transistor modulated output stage. The audio (400 Hz) modulating signal is produced by a PNP transistor oscillator. An external audio signal may be used instead to modulate the carrier.

The r-f output level is indicated on the panel meter. A special fast recovery diode is used as the r-f rectifier to ensure uniform rectification efficiency throughout the frequency coverage of the generator. The r-f voltmeter circuit uses a thermistor to prevent measurement errors due to temperature changes.

The metered r-f voltage is applied to an attenuator which consists of seven switches, each controlling a pi resistive attenuator. The switch attenuator is preferred to the waveguide type in applications up to 100 mc because the minimum insertion loss is zero. The reset accuracy of a switch attenuator is superior since there is no parallax or backlash. Through combinations of the switches, the attenuation may be set to any desired value in increments of 4 db or more. Changes in level of less than 4 db are obtained by varying the setting of the output meter, which is calibrated in one db increments from -4 to +4 db. Precision film resistors are used in the switch attenuator. Gold plated switch contacts are used for long life and dependable operation in this essentially "dry circuit" switching application.

Output calibration is in db with zero db equal to one microvolt across a 50 ohm load. Levels up to 160,000 microvolts (+104 db) or down to 0.6 microvolt (-4 db) are obtainable using the switch attenuator and meter. Accuracy of the output microvolt calibration is within 1 db. Maximum calibrated output of the SG-83C is 160,000 microvolts into a 50 ohm load, or twice this level when driving an open circuit.

A chart on the face of the instrument permits rapid conversion of the db readings into microvolts, and vice versa. For convenience the lines of the chart are offset every 5 db.

Frequency range of the SG-83C is continuous from 50 Khz to 54 Mhz. The range is covered in 6 bands with an average dial scale length of 12 inches on each band. A non-microphonic, ceramic insulated tuning capacitor is used to maintain accurate dial calibration and all frequency determining components are of premium quality. Coil forms are ceramic. The SG-83C dial is easily recalibrated since all calibration adjustments are accessible through the front panel without removing the cabinet or disturbing the shielding. A seventh position on the bandswitch converts the oscillator to 1 Mhz crystal control. Bandswitch insulation is epoxy-glass.

The dial in the SG-83C is driven by a smooth, rim drive, all metal vernier mechanism. The frequency calibration is permanently printed on a metal dial which is gear driven by the tuning capacitor. A hairline dial index, very close to the dial for low parallax, results in a dial of high resolution, readability and reset accuracy. Dial calibration is accurate to 1% or better

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mination on the generator. Modulation per cent should also be set with a level of 0.1 volts at 600 Khz (or 50 Khz if oscilloscope bandwidth is limited). With the meter indicating 50% modulation adjust the "CALIBRATE MODULATION LEVEL" screwdriver setting until B/A = 3/1 in Figure 5. If desired, the modulation may be calibrated at the 30% point on the meter. For 30% modulation, B/A = 1.86.

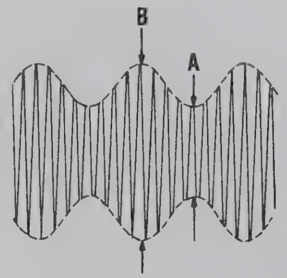


Figure 5 Modulation Envelope

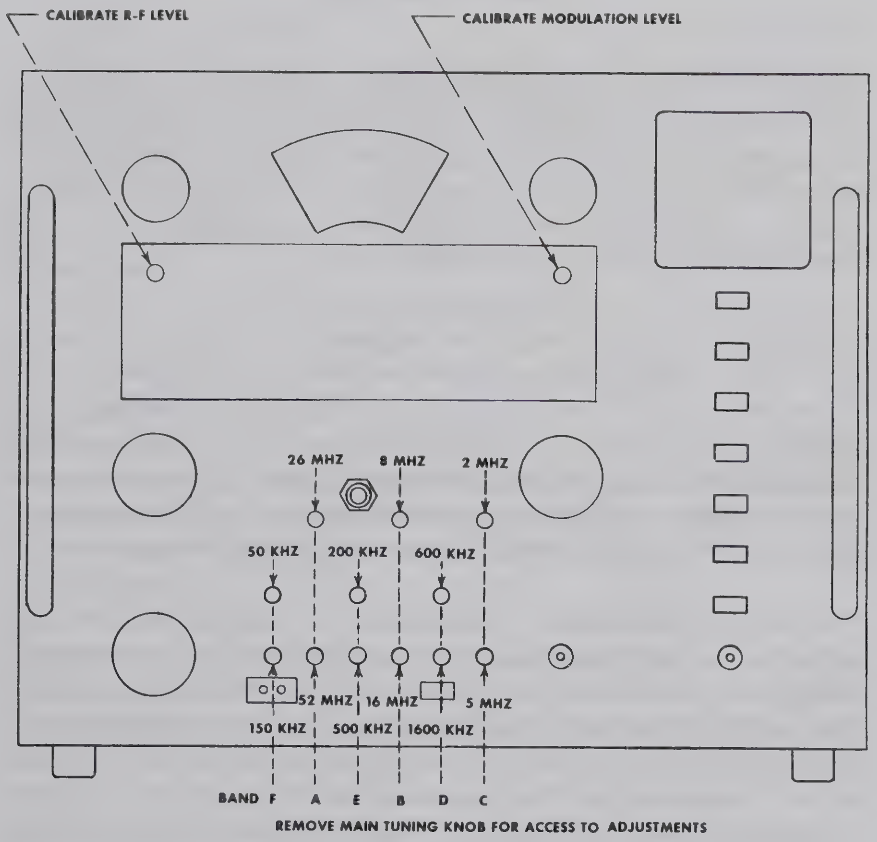
Other percentages of modulation may be computed from the relationship:

$$\% \text{ Mod} = 100 \times \frac{B - A}{B + A}$$

For any desired per cent modulation, the ratio B/A may be calculated from the following formula:

$$\frac{B}{A} = \frac{1 + \frac{\% \text{ Mod}}{100}}{1 - \frac{\% \text{ Mod}}{100}}$$

Although transistors have outstanding advantages in making practical battery operation and in elimination of warm-up drift, the transistor is inherently less tolerant than a vacuum tube to voltage transients. For this reason use of a blocking capacitor in series with the output binding post is recommended in routine work. This will prevent damage to the switch attenuator and output transistor in the event there is accidental contact with the B+ from the equipment under test. For work at 1 Mhz and above, a .01 mfd capacitor is suggested. For lower frequencies,



SG83C Band	Set BC221 to	Adj. Slug	Adj. Trim Cap.
A	1 Mhz	26 Mhz	52 Mhz
B	1 Mhz	8.0 Mhz	16 mc Mhz
C	1 Mhz	2.0 Mhz	5.0 Mhz
D	200 Khz	600 Khz	1600 Khz
E	200 Khz	200 Khz	500 Khz
F	200 Khz	50 Khz	150 Khz

Figure 4 Model SG-83C Alignment Adjustments

Readjustment of the modulation per cent is accomplished by a crewdriver adjustment through the small hole above the MOD ADJ control. The modulation pattern, Fig. 5, should be obtained on an oscilloscope connected across a 50 ohm ter-

on all ranges. Each generator is individually calibrated by adjustment of slotted plates on the tuning capacitor.

The SG-83C may be operated from a battery carried inside the cabinet, or from the built-in power supply which operates from 115 volts, 50-60 Hz. The built-in power supply is well filtered and regulated by a zener diode.

When operating from the internal battery, the line cord may be detached from the cabinet for convenience. With line cord operation, the amount of A.C. power consumed is negligible and is not sufficient to heat the cabinet. There is, of course, no warm-up frequency drift, so that the battery may be conserved by switching the generator off between tests. A standard, inexpensive, 9-volt transistor battery is used, available at radio, drug, or hardware stores. The battery mounts in a clip and may be easily changed without tools by removing only the outer cabinet thumbscrews.

An output cable with binding posts, terminating resistor, and switch is supplied. The switch permits the terminating resistor to be removed whenever the equipment under test presents a terminating load for the cable. A detachable line cord is also furnished, plus a heavy-gauge, clear vinyl dust jacket for the generator.

APPLICATIONS

The SG-83C is ideal for:

- Crystal and mechanical filter response curves — r-f, mixer, and i-f amplifier gain, bandwidth, regeneration, measurements
- Image rejection tests
- Signal to noise ratio tests
- Comparison of antennas and beam antenna front/back ratio
- S-Meter calibration
- Production alignment of communications equipment
- Field servicing of jungle, mobile and aeronautical radios
- Repair of delicate transient susceptible transistor radios

OPERATION

The Model SG-83C Standard Signal Generator may be operated from either battery or the 115 volt A.C. line. The generator is shipped without the battery. A 9 volt transistor battery (NEDA type 1600; Eveready No. 226, RCA No. VS300A, Burgess P6 or PM6) should be installed when the generator is received. This is done by removing the knurled thumbscrews which secure the front panel to the outer cabinet. The battery may then be snapped into the mounting clip, taking care to observe the polarity marking. Inserting the battery with the polarity reversed will not damage the signal generator but will subject the battery to a current drain ten times normal.

A zener diode regulates the A.C. power supply to prevent frequency changes from line voltage changes. The zener voltage is 13.0 volts, slightly higher than the battery supply voltage. As a result, the zener regulator does not consume power when operating from the battery, and the regulator will not prevent changes in the supply voltage due to bandswitching, which causes slight power supply load change. Having a battery in the mounting clip at all times will prevent the small supply voltage changes due to bandswitching.

Since the battery acts as a very effective voltage regulator when operating from the A.C. line, it is recommended that a battery be installed, even though it is not absolutely necessary if line operation only is required. No damage will result if the generator is operated without the battery.

The SG-83C power transformer is designed for operation from 50-60 Hz, but operates equally well from a line frequency of 400 Hz.

If operation is desired from 230 volts, an external autotransformer is recommended. A recommended autotransformer is the Knight 6K68HF, available from Allied Radio Corp., 100 N. Western Avenue, Chicago, Illinois 60680. If desired the

MAINTENANCE

Periodic battery replacement when necessary requires installation of a fresh NEDA 1600 battery in the mounting clip, taking care to observe the marked polarity. Inserting the battery with the polarity reversed will not damage the signal generator, but will subject the battery to a current drain ten times normal. The correct battery is:

Eveready No. 226
RCA No. VS300A
Burgess P6 or PM6

Replacement batteries should be stored in a cool place or refrigerator to obtain long shelf life. These batteries may be kept in perfect condition for years if stored near zero degrees F, producing full output after returning to room temperature.

Frequency recalibration is performed by two screwdriver adjustments on each band as shown on Figure 4. Each adjustment should be repeated several times for greatest accuracy. Frequency calibration adjustments are most conveniently made with the aid of a frequency meter such as the BC-221 or LM-series of instruments. The frequency meter should be set to the frequencies given in Figure 4. These frequency meter settings will produce clear, distinct beats.

Recalibration of the r-f output level is not likely to be required but should it become necessary it is accomplished by a screwdriver adjustment through the small hole above the bandswitch as shown in Figure 4. Set the generator for 0.1 volt output at 600 Khz as indicated on a suitable voltmeter, such as a Hewlett-Packard Model 400, Eico Model 250, or other accurate meter, connected across the output cable binding posts with the switch in the TERM position. Set the "CALIBRATE RF LEVEL" screwdriver adjustment so that the SG-83C meter reads zero db with 0.1 volts output. (This adjustment may be performed at 50 Khz instead of 600 Khz if the voltmeter used is not accurate at 600 Khz.)

charging current will flow through the battery during line voltage operation. The charging current will be greatest (approximately 2 ma) when the bandswitch is set for 1 Mhz (Xtal). The charging rate is not affected by the other controls. The charging current drops off as the battery terminal voltage rises above 9.7 volts so the battery will not overcharge. (A "9 volt" transistor battery has a terminal voltage of about 9.7 volts when new.)

When the battery is expended, its output voltage will drop and this will cause a decrease in the output indicated on the meter. As long as it is possible to set the meter to the desired db calibration line on the meter, accuracy of the output voltage is not affected by the decreased battery voltage. A depleted battery should be replaced promptly, however, to prevent corrosion of the battery clip, and preserve the voltage regulating effect of the battery.

In normal operation the generator draws 15 ma from the battery or A.C. power supply. At this drain the NEDA 1600 battery will provide about 40 hours of intermittent operation.

autotransformer may be placed inside the SG-83C cabinet. Wiring for the built-in arrangement is shown below.

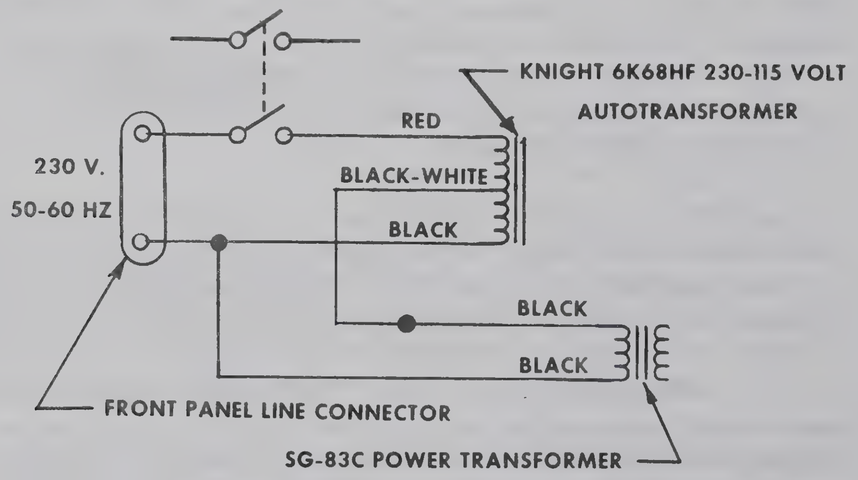

KNIGHT 6K68HF 230-115 VOLT AUTOTRANSFORMER
RED
230 V.
50-60 HZ
BLACK-WHITE
BLACK
BLACK
BLACK
FRONT PANEL LINE CONNECTOR
SG-83C POWER TRANSFORMER

Fig. 3. Suggested Modification for 230 Volt Operation

The Model SG-83C Standard Signal Generator has the following operating controls:

(a) *OFF-ON Switch:* The power switch is a two-position slide switch which turns the generator off and on with either battery or 115 volt line operation.

(b) *115V Connector:* The line cord may be disconnected, if desired, for portable battery operation. When operating from a fresh battery, connecting the line cord will cause a slight increase in the r-f output meter reading, typically of less than one db. If there is an increase of *more* than about 2 db in the meter reading when the line cord is connected, the battery should be replaced. The battery may be left in place at all times since a small "trickle" charging current will flow into the battery during line voltage operation. The battery will not overcharge. A weak battery does not affect the accuracy of the output voltage calibration, but a depleted battery should be replaced to prevent corrosion of the battery mounting clip.

(c) *EXT MOD Connector:* A BNC Connector is used for injecting external modulating voltage. The input impedance at this jack is 2500 ohms at 1000 Hz. One and one-half volts rms must be applied to obtain 50% modulation. Do not apply more than 10 volts to the external modulation jack to avoid possible damage to the modulation meter. Shielded coaxial cable should be used to connect the external modulating voltage since r-f leakage of several microvolts may otherwise occur from wiring to the EXT MOD connector.

(d) *METER Switch:* This switch connects the meter to read either the r-f output level, which is calibrated from -4 to +4 db, (zero db center scale) or the degree of modulation, which is calibrated in percent to 50% (full scale).

(e) *MODULATION Switch:* This switch connects the modulating circuits to the internal audio oscillator or to the external modulation jack. (The internal modulating oscillator may be modified if desired for 1000 Hz modulation. For 1000 Hz operation, capacitors C29, C31 and C32 are .015 mfd. Resistor R44 is 3.9 K.)

(f) *MOD ADJ Control:* This control is used to vary the level of internal or external modulation from zero to 50%.

(g) *BAND Switch:* The bandswitch selects the desired frequency range in six positions and 1 Mhz crystal in its seventh position. Strong harmonics of the 1 Mhz crystal output thru 54 Mhz can be obtained when desired by setting the RF ADJ control at a high output position. This overdrives the output amplifier and produces strong harmonics.

(h) *Main Tuning:* The main tuning control and dial indicate the output frequency. Tuning rate is 17% frequency change per revolution.

(i) *RF ADJ Control:* The RF ADJ control is a potentiometer which varies the r-f level and the output meter. Varying this control may cause a very slight change in the

justed if adequate test equipment is available, as described under MAINTENANCE.

The seven switches which control individual pi attenuators may be used in any combination. Each attenuator consists of three precision resistors and is accurate to within 0.1 db.

The pi connection inherently provides a stable attenuator. A shift of all three of the resistors of +5% due to age or temperature, for example, would not change the attenuation by more than 1%. This is because the increase in the series resistance compensates for the increase in the shunt resistance. Such a resistance change, is of course, virtually impossible with the film resistors used. The actual attenuation obtained with any combination of attenuator switch settings will be within 1/4 db of the nominal attenuation.

Internal modulation is obtained from a transistor audio oscillator. This oscillator is of the phase shift type in which the primary frequency determining elements are three capacitors and three resistors. As a result of averaging the values of these six components, the frequency accuracy is within 5%. The level of the modulating voltage is controlled by the MOD ADJ panel potentiometer. The output from this potentiometer is applied to the modulator stage through a second (screwdriver adjusted) potentiometer which is factory set for 50% modulation at this indicated level. This setting may also be checked and readjusted as described under MAINTENANCE. The per cent modulation is not affected by varying the r-f output level over the calibrated range.

All circuits in the generator are designed for nominal 9 volt operation. The 9 volt potential is obtained from a full wave, well filtered supply operating from 115 volts, 50-60 hz. A 9-volt transistor battery should be installed in the battery mounting clip inside the cabinet. Although it is not essential to have the battery in place, its use is recommended since it is a very effective regulator for the supply voltage and it will prevent frequency changes due to line voltage surges. A small "trickle"

THEORY OF OPERATION

The SG-83C uses a silicon, N-channel, field effect transistor oscillator to generate a carrier signal tunable from 50 Khz to 54 Mhz in six bands. The r-f field inside the shield of the oscillator is relatively weak which minimizes the external leakage field. Maximum r-f voltage across the oscillator tuned circuit is only 2.5 volts. Due to the low power level there is no warm-up frequency drift. High quality, low hygroscopic components are used, including a ceramic insulated tuning capacitor and ceramic coil forms. Stable plunger style trimmer capacitors are used. The bandswitch insulation is epoxy glass. All of these measures contribute to excellent long term and short term frequency stability. The oscillator waveform has low harmonic content because the high input impedance of the FET does not load the tuned circuit.

Output is taken from the oscillator across the tuned circuit where the waveform is most pure. A silicon transistor emitter follower stage is used, which has high input impedance, to avoid tuned circuit loading. The emitter follower stage has low output impedance and serves as a buffer between the oscillator and the following modulated amplifier.

The modulated amplifier is a silicon PNP transistor. Bias is set for nonlinear operation so that the carrier signal can be modulated by simultaneous injection of audio and r-f signals.

The r-f output voltage is measured by a special rectifier diode which has constant rectifying action over the frequency range of the generator. No d-c amplification is used in the r-f metering circuit to avoid temperature sensitivity and consequent inaccuracy of the voltmeter. The effect of temperature on the meter and diode is eliminated by a thermistor across the meter.

A screwdriver adjusted potentiometer in the modulator output circuit is used to set the r-f output voltage to the indicated level. This is a factory setting which may be easily checked and read-

generator frequency. Over the -4 db to +4 db meter scale, this frequency effect will be no more than .01% . At a fixed setting of the R-F ADJ control, the output variation across any band does not exceed 6 db.

(j) *R-F Attenuator Switches:* There are seven slide switches, each controlling a separate resistive attenuator. The output voltage of the signal generator is calibrated in db with zero db equal to one microvolt across a 50 ohm load. By using the 7 slide switches it is possible to obtain other output voltages. The output in db is the sum of the db readings from the seven switches, plus the db reading of the output meter. A chart on the front panel allows convenient conversion of the db readings to microvolts, and vice versa. The attenuator switch contacts are gold plated for long life and reliability.

(k) *R-F Output Connector:* R-F output from the generator is obtained from the R-F BNC connector. In order for the output voltage calibration to be correct, it is necessary to have a 50 ohm load on the output connector.

* * *

The SG-83C is calibrated in terms of the voltage across the 50 ohm load. This convention has been adopted by most manufacturers of standard signal generators. Some other manufacturers use a different convention, calibrating their generators in terms of the internal "constant voltage" which precedes an internal 50 ohm resistor. The output across a 50 ohm load is one-half the output indicated by these generators. This difference must be taken into account in making comparisons with the SG-83C.

So long as the output meter reading is held constant, the *open circuit* output voltage from the SG-83C will be twice the calibrated voltage across a 50 ohm load. The output meter reading will increase if all load is removed from the generator. The RF ADJ control is used to reset the meter to the original reading to maintain constant voltage.

The termination cable furnished with the SG-83C may be used to make convenient binding post connections to equipment under test. The termination cable has a two position slide switch marked "TERM" and "OPEN". In the "TERM" switch position, a 50 ohm resistor in the termination unit is connected across the output cable. The signal generator output in microvolts will then appear across the binding posts. The "TERM" switch position is used when the generator is connected to a *high* impedance load, such as the grid of a vacuum tube amplifier or the input of any high impedance amplifier. If the generator is connected to a 50 ohm load, or *low* impedance load such as the antenna terminals of the average communications receiver, the switch on the termination unit should be in the "OPEN" position since the receiver antenna circuit will provide the load for the signal generator.

Some signal generators are calibrated in both microvolts and dbm, or db referred to one milliwatt. One microvolt across a 50 ohm load is a level of -107 dbm. The db output scale of the SG-83C is referred to one microvolt across 50 ohms because it is less confusing to add positive db switch settings rather than negative numbers. The db readings of the SG-83C may be converted to dbm by adding -107. For example, a level of +12 db, or 4 uV, is +12 -107 or -95 dbm.

Use of a blocking capacitor in series with the output binding post is recommended to prevent accidental application of B+ from equipment under test to the signal generator output circuit and attenuator. For work above 1 Mhz, a .01 mfd blocking capacitor is suggested. Larger capacity may be desired at lower frequencies.

Calibrated levels lower than 0.6 uV are best obtained by using an external attenuator. The leakage from the SG-83C is sufficiently low that dependable tests may be made at 0.1 uV and below by this method. A suitable 20 db attenuator with BNC connectors is the type 011-0059-00 manufactured by Tektronix, Inc., Box 500, Beaverton, Oregon 97005.

Frequency stability of the SG-83C is excellent. The warm-up frequency drift so annoying in vacuum tube signal generators is completely eliminated. In normal indoor laboratory use where the temperature is rather constant, the SG-83C will hold frequency within .01% per hour. The best available vacuum tube generator will reach this stability only after several hours warm-up, if at all.

The output stage is a video amplifier which operates from 50 Khz to 54 Mhz. The gain of this amplifier has some degree of frequency dependence. An emitter peaking circuit is used to compensate for some of this frequency effect. An effect of the frequency dependent gain variation is some variation in the per cent modulation with frequency. The effect is negligible at carrier frequencies up to 30 Mhz.

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THEORY OF OPERATION

The SG-83C uses a silicon, N-channel, field effect transistor oscillator to generate a carrier signal tunable from 50 Khz to 54 Mhz in six bands. The r-f field inside the shield of the oscillator is relatively weak which minimizes the external leakage field. Maximum r-f voltage across the oscillator tuned circuit is only 2.5 volts. Due to the low power level there is no warm-up frequency drift. High quality, low hygroscopic components are used, including a ceramic insulated tuning capacitor and ceramic coil forms. Stable plunger style trimmer capacitors are used. The bandswitch insulation is epoxy glass. All of these measures contribute to excellent long term and short term frequency stability. The oscillator waveform has low harmonic content because the high input impedance of the FET does not load the tuned circuit.

Output is taken from the oscillator across the tuned circuit where the waveform is most pure. A silicon transistor emitter follower stage is used, which has high input impedance, to avoid tuned circuit loading. The emitter follower stage has low output impedance and serves as a buffer between the oscillator and the following modulated amplifier.

The modulated amplifier is a silicon PNP transistor. Bias is set for nonlinear operation so that the carrier signal can be modulated by simultaneous injection of audio and r-f signals.

The r-f output voltage is measured by a special rectifier diode which has constant rectifying action over the frequency range of the generator. No d-c amplification is used in the r-f metering circuit to avoid temperature sensitivity and consequent inaccuracy of the voltmeter. The effect of temperature on the meter and diode is eliminated by a thermistor across the meter.

A screwdriver adjusted potentiometer in the modulator output circuit is used to set the r-f output voltage to the indicated level. This is a factory setting which may be easily checked and read-

generator frequency. Over the -4 db to +4 db meter scale, this frequency effect will be no more than .01% . At a fixed setting of the R-F ADJ control, the output variation across any band does not exceed 6 db.

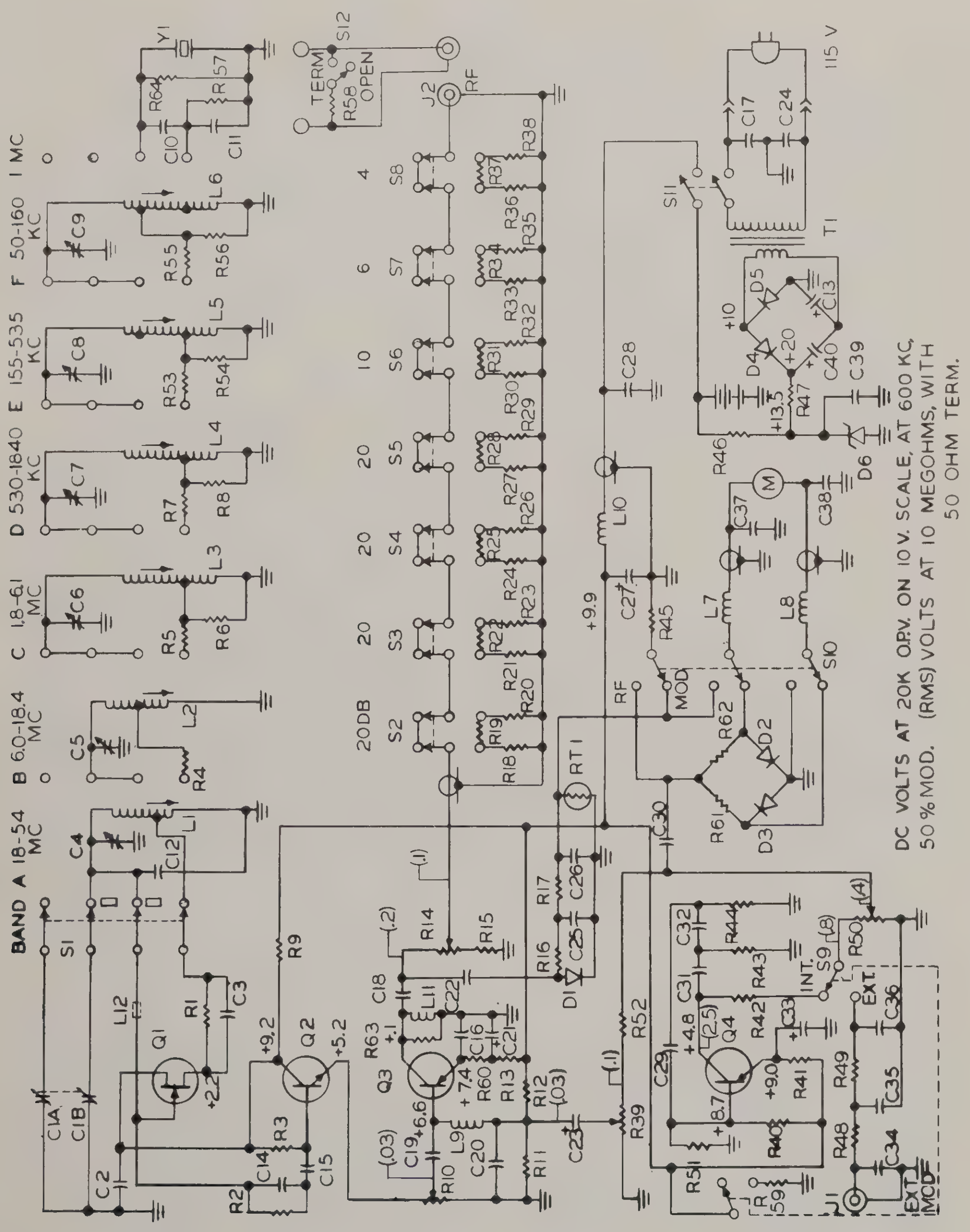
(j) *R-F Attenuator Switches:* There are seven slide switches, each controlling a separate resistive attenuator. The output voltage of the signal generator is calibrated in db with zero db equal to one microvolt across a 50 ohm load. By using the 7 slide switches it is possible to obtain other output voltages. The output in db is the sum of the db readings from the seven switches, plus the db reading of the output meter. A chart on the front panel allows convenient conversion of the db readings to microvolts, and vice versa. The attenuator switch contacts are gold plated for long life and reliability.

(k) *R-F Output Connector:* R-F output from the generator is obtained from the R-F BNC connector. In order for the output voltage calibration to be correct, it is necessary to have a 50 ohm load on the output connector.

* * *

The SG-83C is calibrated in terms of the voltage across the 50 ohm load. This convention has been adopted by most manufacturers of standard signal generators. Some other manufacturers use a different convention, calibrating their generators in terms of the internal "constant voltage" which precedes an internal 50 ohm resistor. The output across a 50 ohm load is one-half the output indicated by these generators. This difference must be taken into account in making comparisons with the SG-83C.

So long as the output meter reading is held constant, the *open circuit* output voltage from the SG-83C will be twice the calibrated voltage across a 50 ohm load. The output meter reading will increase if all load is removed from the generator. The RF ADJ control is used to reset the meter to the original reading to maintain constant voltage.



DC VOLTS AT 20K O.P.V. ON 10 V. SCALE, AT 600 KC, 50% MOD. (RMS) VOLTS AT 10 MEGOHMS, WITH 50 OHM TERM.

Figure 7 Model SG-83C Schematic Diagram

SPECIFICATIONS

Frequency Ranges:
Band A: 18 — 54 Mhz
Band B: 6.0 — 18.4 Mhz
Band C: 1.8 — 6.1 Mhz
Band D: 530 — 1840 Khz
Band E: 155 — 530 Khz
Band F: 50 — 155 Khz

Calibration: Frequency is indicated to an accuracy of 1% or better.

Output: 0.6 to 160,000 microvolts across a 50 ohm load in 1 db steps. Output is factory adjusted to 100,000 microvolts at 600 Khz. The output meter and switch attenuators are accurate to within one db of the calibrated output at any other setting throughout the frequency range of the instrument. Leakage fields are equivalent to less than 0.1 microvolt at the output terminals.

Modulation: Amplitude modulation is variable from zero to 50%. The percent modulation is indicated on the panel meter to an accuracy of ± 10% for carrier frequencies up to 30 Mhz. Internal modulation is 400 Hz ± 5% with less than 10% distortion. Input impedance at the external modulation jack is 2500 ohms at 1000 Hz. An input of 1.5 volts rms is required for 50% modulation at maximum setting of the modulation level control. Modulation is flat within 1 db from 100 Hz to 5000 Hz and within 3 db from 50 Hz to 10,000 Hz. Incidental frequency modulation is negligible below 30 Mhz and less than .05% at 50 Mhz.

Crystal Calibrator: In the seventh bandswitch position, the r-f oscillator is crystal controlled at 1 Mhz. Harmonics are usable to 30 Mhz or higher. Crystal frequency accuracy is better than .005%.

Power Supply: Operation for 40 hours, or approximately 4 months in average intermittent use of 1/2 hour per day, from

NEDA 1600 9 volt transistor battery (not supplied). Alternate operation from 115 volts, 50-60 Hz. Power consumption 1 watt.

Size: 10-1/2'' high, 12-1/2'' wide, 7-1/2'' deep. Shipping weight 19 pounds. Supplied with detachable line cord, four foot output cable, heavy vinyl dust cover, and two copies of the Instruction Manual.

PRICE and DELIVERY

The SG-83C Standard Signal Generator, with output and power cables, and two copies of the Instruction Manual . . . $295.00 f.o.b. St. Louis. Immediate shipment from stock.

R8 470 5%
R9 51 5%
R10 1K 10%
R11 10K 5%
R12 4.7K 5%
R13 470 5%
R14 100 10%
R15 470 5%
R16 1K 5%
R17 1K 5%
R18 62 2%
R19 249 1%
R20 62 2%
R21 62 2%
R22 249 1%
R23 62 2%
R24 62 2%
R25 249 1%
R26 62 2%
R27 62 2%
R28 249 1%
R29 62 2%
R30 100 2%

R31 75 2%
R32 100 2%
R33 150 2%
R34 37.4 1%
R35 150 2%
R36 220 2%
R37 23.7 1%
R38 220 2%
R39 1K 10%
R40 2.7K 5%
R41 470 5%
R42 2.2K 5%
R43 3.3K 5%
R44 2.7K 5%
R45 8.2K 5%
R46 220 5%
R47 240 5%
R48 1K 5%
R49 1K 5%
R50 1.5K 10%
R51 27K 5%
R52 2.2K 5%
R53 1K 5%

R54 470 5%
R55 470 5%
R56 560 5%
R57 2.2K 5%
R58 51 2%
R59 6.2K 5%
R60 3.3 5%
R61 2.2K 5%
R62 2.2K 5%
R64 220K 10%

RT1 KA35J3 FENWAL
5000 Ohms
at 25°C

T1 PRI. 115V.
50-60 CPS
Sec. 6V.

Y1 1.000 MC.

PARTS LIST

C1	10-272 pf. 2 gang
C2	.1 mfd. 10% mylar
C3	.01 mfd. ceramic
C4	1-8 pf. variable
C5	1-8 pf. variable
C6	1-8 pf. variable
C7	1-8 pf. variable
C8	1-8 pf. variable
C9	1-8 pf. variable
C10	15 pf. 5% mica
C11	100 pf. 5% mica
C12	15 pf. 5% mica
C13	100 mfd 16V electrolytic
C14	2 pf. 5% mica
C15	.001 mfd. 10% mylar
C16	.0047 mfd. 20% ceramic
C17	.0047 mfd. 1400V.
C18	.047 mfd. 10% mylar
C19	.047 mfd. 10% mylar
C20	.01 mfd. ceramic
C21	100 mfd. 16V. electrolytic
C22	.047 mfd. 10% mylar
C23	100 mfd. 16V. electrolytic
C24	.0047 mfd. 1400 V.
C25	.01 mfd. ceramic
C26	.01 mfd. ceramic
C27	100 mfd. 16V. electrolytic
C28	.01 mfd. ceramic
C29	.047 mfd. 10% mylar
C30	1.0 mfd. 10% mylar
C31	.047 mfd. 10% mylar
C32	.047 mfd. 10% mylar
C33	100 mfd. 16V electrolytic
C34	.001 mfd. 10% mylar
C35	.01 mfd. ceramic
C36	.01 mfd. ceramic
C37	.001 mfd. 10% mylar
C38	.001 mfd. 10% mylar
C39	100 mfd.
C40	100 mfd. 16V. electrolytic
D1	HD1811
D2	1N34A
D3	1N34A
D4	1N2482
D5	1N2482
D6	1N964B
Ll	.17 uh
L2	1.7 uh
L3	13 uh
L4	160 uh
L5	1.7 mh
L6	19 mh
L7	250 uh
L8	250 uh
L9	1.5 mh
L10	250 uh
L11	1.5 mh
L12	Ferrite Bead
M	50 uA
Q1	2N5485
Q2	MPS6514
Q3	MPS6518
Q4	2N508
R1	470 5%
R2	220K 10%
R3	100K 10%
R4	470 5%
R5	240 5%
R6	1K 5%
R7	470 5%

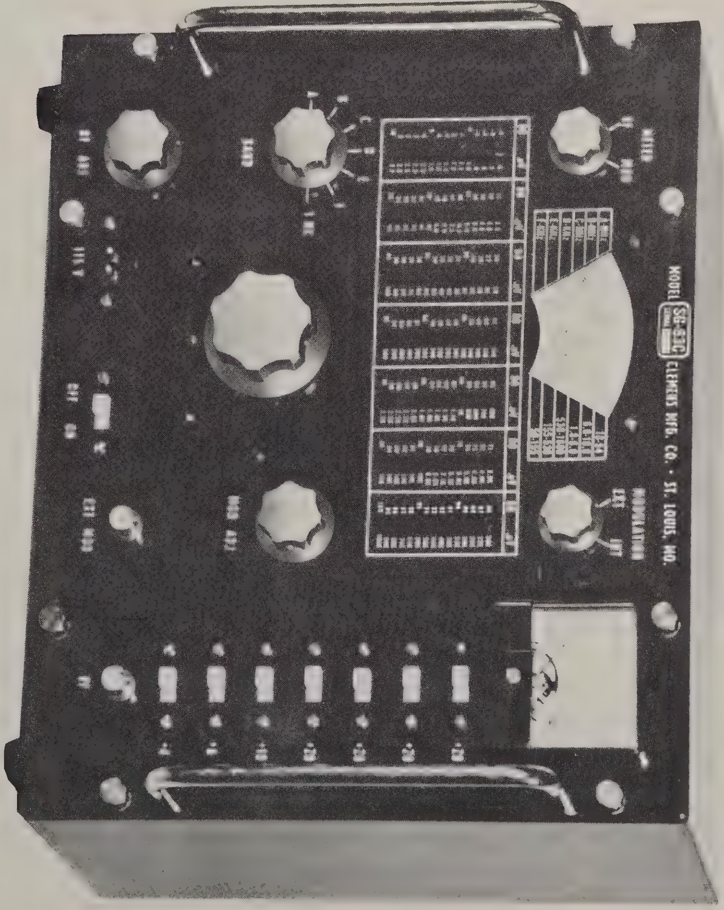


Figure 1 Model SG-83C
Standard Signal Generator

STANDARD SIGNAL GENERATOR
MODEL SG-83C
DESCRIPTION

The first all solid-state Standard Signal Generator, with output accurately calibrated in microvolts, was the Model SG-83 introduced by Clemens Manufacturing in 1962 and now in use throughout the world. This model was followed by improved designs, the Model SG-83A, introduced in 1964, and the Model SG-83B introduced in 1966. The Model SG-83C Standard Signal Generator is a new design which supersedes the previous Model SG-83B.

Model SG-83C incorporates a silicon field effect transistor oscillator, a silicon transistor emitter follower buffer, and a silicon transistor output amplifier. The new design produces an output r-f signal with much purer waveform. No distortion of the r-f signal is visible on a wideband oscilloscope. As a consequence of the low distortion r-f waveform, the modulation envelope has excellent symmetry. High order harmonics are greatly reduced. The second harmonic is 20 db below the fundamental output, and higher harmonics are 40 db or more below the fundamental (typical values). The low cost SG-83C has many desirable features in common with the most expensive standard signal generators. Standard signal generators

SG-83C PERFORMANCE FEATURES

- 50 Khz to 54 Mhz Coverage, 1% Frequency Calibration
- Output Calibrated 0.6 Microvolt to 160,000 Microvolts (.16 volt)
- 1 Mhz Crystal Operation
- Per Cent Modulation Variable 0 to 50% (Indicated on Meter)
- External Modulation Connector
- Operates from Internal Battery or from 115 Volts 50-60 Hz
- BNC Connectors

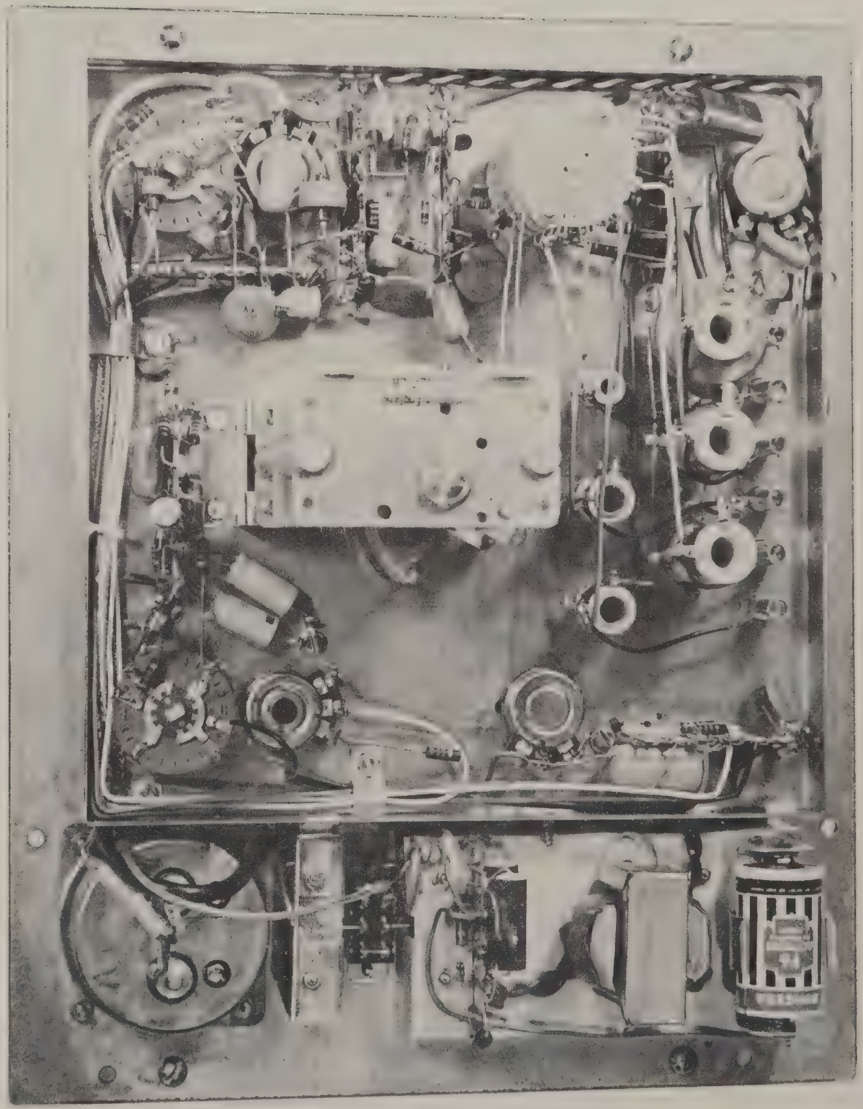


Figure 6 Interior View With Shield Removed

higher capacity may be preferred. It is also possible to destroy the output transistor if a transceiver under test is accidentally turned to transmit while connected to the SG-83C. The switch attenuator can withstand the steady application of up to 4 volts D.C. or rms without damage.

Field replacement of transistors is not difficult and will not invalidate the microvolt calibration of the SG-83C. It is not necessary to return the generator to the factory. The shielded switch attenuator need not be disturbed. Only the shield over the generator assembly is removed, by removal of sixteen screws.

If the audio oscillator transistor, Q4 (type 2N508) is damaged, it can be replaced without affecting the modulation frequency, per cent, or waveform.

If the r-f output transistor, Q3 (type MPS6518) is damaged, it can be replaced *without affecting the microvolt calibration in any way.* The per cent modulation will require recalibration with an oscilloscope, as described above.

The oscillator transistor, Q1, (type 2N5485) can be replaced also *without affecting the microvolt calibration.* Replacement may cause a slight change in the frequency calibration, although usually the change will not exceed the 1% calibration tolerance. If the frequency dial calibration error is excessive after oscillator tranistor replacement, the dial may be recalibrated with a frequency meter as described above.

The emitter follower transistor, Q2 (type MPS6514) may also be replaced without effect on either the frequency, microvolt, or modulation calibration.

Correct D.C. voltages are shown on the schematic diagram at a number of circuit points as an aid to troubleshooting. All D.C. voltages under 10 volts are read on the 10 volt scale of a 20,000 ohms per volt meter. R-F and audio frequency voltages are also shown in parentheses. These are read with an A.C. meter such as the Hewlett Packard 400 or Eico 250.

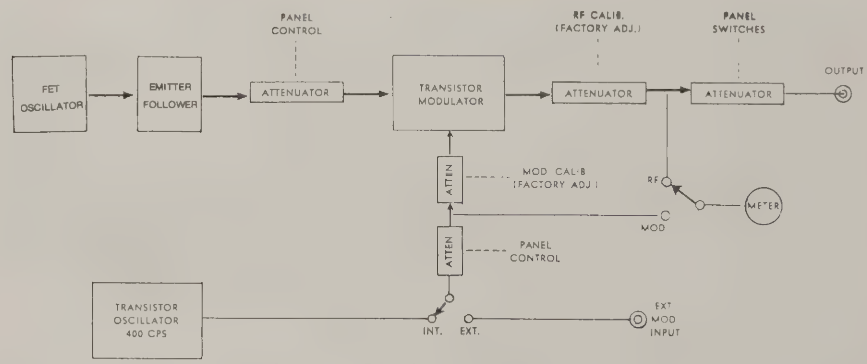


Figure 2 Block Diagram

from Clemens Manufacturing are in use in the largest industrial, university, and U.S. Government laboratories. Those engaged in communications circuit development will find the SG-83C indispensable. The low cost and stability of the SG-83C also make it ideal for production line alignment stations.

A silicon, N-Channel, field effect transistor oscillator is used in the SG-83C. A ferrite bead in the oscillator circuit prevents high frequency parasitic oscillations. The oscillator is followed by a silicon NPN transistor emitter follower to buffer the oscillator from the modulated output amplifier as a precaution against frequency modulation. Following the buffer stage is a silicon PNP transistor modulated output stage. The audio (400 Hz) modulating signal is produced by a PNP transistor oscillator. An external audio signal may be used instead to modulate the carrier.

The r-f output level is indicated on the panel meter. A special fast recovery diode is used as the r-f rectifier to ensure uniform rectification efficiency throughout the frequency coverage of the generator. The r-f voltmeter circuit uses a thermistor to prevent measurement errors due to temperature changes.

The metered r-f voltage is applied to an attenuator which consists of seven switches, each controlling a pi resistive attenuator. The switch attenuator is preferred to the waveguide type in applications up to 100 mc because the minimum insertion loss is zero. The reset accuracy of a switch attenuator is superior since there is no parallax or backlash. Through combinations of the switches, the attenuation may be set to any desired value in increments of 4 db or more. Changes in level of less than 4 db are obtained by varying the setting of the output meter, which is calibrated in one db increments from -4 to +4 db. Precision film resistors are used in the switch attenuator. Gold plated switch contacts are used for long life and dependable operation in this essentially "dry circuit" switching application.

Output calibration is in db with zero db equal to one microvolt across a 50 ohm load. Levels up to 160,000 microvolts (+104 db) or down to 0.6 microvolt (-4 db) are obtainable using the switch attenuator and meter. Accuracy of the output microvolt calibration is within 1 db. Maximum calibrated output of the SG-83C is 160,000 microvolts into a 50 ohm load, or twice this level when driving an open circuit.

A chart on the face of the instrument permits rapid conversion of the db readings into microvolts, and vice versa. For convenience the lines of the chart are offset every 5 db.

Frequency range of the SG-83C is continuous from 50 Khz to 54 Mhz. The range is covered in 6 bands with an average dial scale length of 12 inches on each band. A non-microphonic, ceramic insulated tuning capacitor is used to maintain accurate dial calibration and all frequency determining components are of premium quality. Coil forms are ceramic. The SG-83C dial is easily recalibrated since all calibration adjustments are accessible through the front panel without removing the cabinet or disturbing the shielding. A seventh position on the bandswitch converts the oscillator to 1 Mhz crystal control. Bandswitch insulation is epoxy-glass.

The dial in the SG-83C is driven by a smooth, rim drive, all metal vernier mechanism. The frequency calibration is permanently printed on a metal dial which is gear driven by the tuning capacitor. A hairline dial index, very close to the dial for low parallax, results in a dial of high resolution, readability and reset accuracy. Dial calibration is accurate to 1% or better

mination on the generator. Modulation per cent should also be set with a level of 0.1 volts at 600 Khz (or 50 Khz if oscilloscope bandwidth is limited). With the meter indicating 50% modulation adjust the "CALIBRATE MODULATION LEVEL" screwdriver setting until B/A = 3/1 in Figure 5. If desired, the modulation may be calibrated at the 30% point on the meter. For 30% modulation, B/A = 1.86.

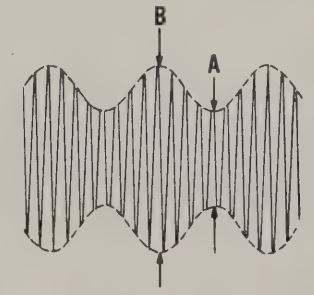


Figure 5 Modulation Envelope

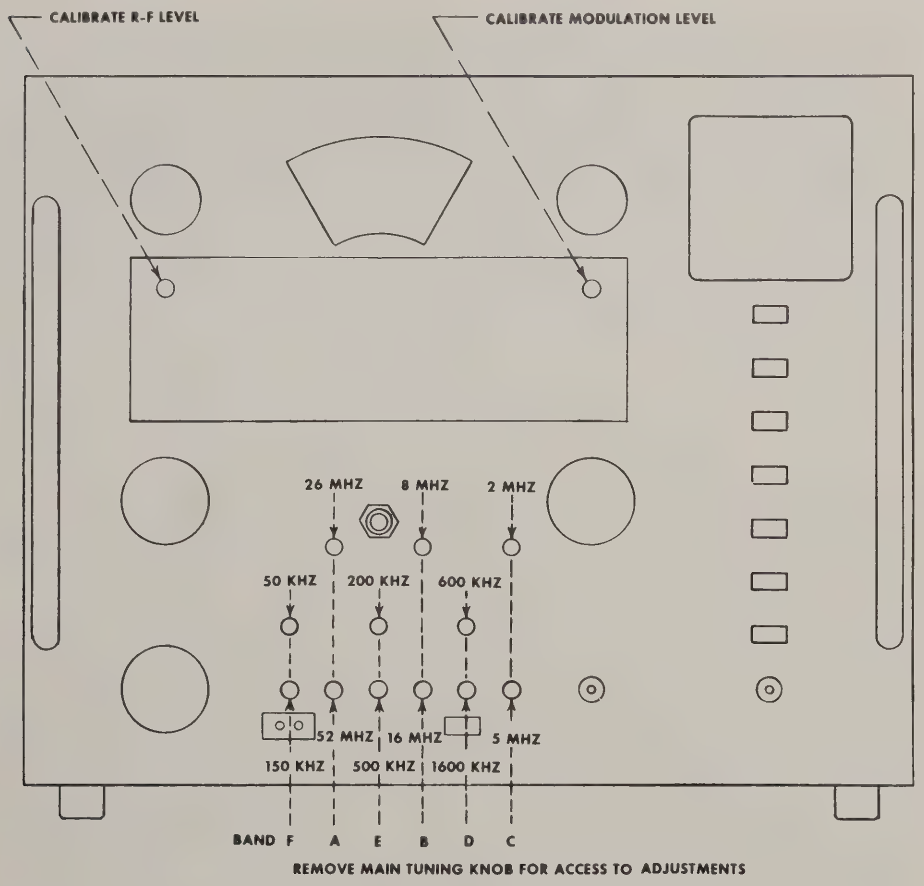
Other percentages of modulation may be computed from the relationship:

$$\% \text{ Mod} = 100 \times \frac{B - A}{B + A}$$

For any desired per cent modulation, the **ratio B/A** may be calculated from the following formula:

$$\frac{B}{A} = \frac{1 + \frac{\% \text{ Mod}}{100}}{1 - \frac{\% \text{ Mod}}{100}}$$

Although transistors have outstanding advantages in making practical battery operation and in elimination of warm-up drift, the transistor is inherently less tolerant than a vacuum tube to voltage transients. For this reason use of a blocking capacitor in series with the output binding post is recommended in routine work. This will prevent damage to the switch attenuator and output transistor in the event there is accidental contact with the B+ from the equipment under test. For work at 1 Mhz and above, a .01 mfd capacitor is suggested. For lower frequencies,



SG83C Band	Set BC221 to	Adj. Slug	Adj. Trim Cap.
A	1 Mhz	26 Mhz	52 Mhz
B	1 Mhz	8.0 Mhz	16 mc Mhz
C	1 Mhz	2.0 Mhz	5.0 Mhz
D	200 Khz	600 Khz	1600 Khz
E	200 Khz	200 Khz	500 Khz
F	200 Khz	50 Khz	150 Khz

Figure 4 Model SG-83C Alignment Adjustments

Readjustment of the modulation per cent is accomplished by a crewdriver adjustment through the small hole above the MOD ADJ control. The modulation pattern, Fig. 5, should be obtained on an oscilloscope connected across a 50 ohm ter-

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on all ranges. Each generator is individually calibrated by adjustment of slotted plates on the tuning capacitor.

The SG-83C may be operated from a battery carried inside the cabinet, or from the built-in power supply which operates from 115 volts, 50-60 Hz. The built-in power supply is well filtered and regulated by a zener diode.

When operating from the internal battery, the line cord may be detached from the cabinet for convenience. With line cord operation, the amount of A.C. power consumed is negligible and is not sufficient to heat the cabinet. There is, of course, no warm-up frequency drift, so that the battery may be conserved by switching the generator off between tests. A standard, inexpensive, 9-volt transistor battery is used, available at radio, drug, or hardware stores. The battery mounts in a clip and may be easily changed without tools by removing only the outer cabinet thumbscrews.

An output cable with binding posts, terminating resistor, and switch is supplied. The switch permits the terminating resistor to be removed whenever the equipment under test presents a terminating load for the cable. A detachable line cord is also furnished, plus a heavy-gauge, clear vinyl dust jacket for the generator.

APPLICATIONS

The SG-83C is ideal for:

- Crystal and mechanical filter response curves — r-f, mixer, and i-f amplifier gain, bandwidth, regeneration, measurements
- Image rejection tests
- Signal to noise ratio tests
- Comparison of antennas and beam antenna front/back ratio
- S-Meter calibration
- Production alignment of communications equipment
- Field servicing of jungle, mobile and aeronautical radios
- Repair of delicate transient susceptible transistor radios

OPERATION

The Model SG-83C Standard Signal Generator may be operated from either battery or the 115 volt A.C. line. The generator is shipped without the battery. A 9 volt transistor battery (NEDA type 1600; Eveready No. 226, RCA No. VS300A, Burgess P6 or PM6) should be installed when the generator is received. This is done by removing the knurled thumbscrews which secure the front panel to the outer cabinet. The battery may then be snapped into the mounting clip, taking care to observe the polarity marking. Inserting the battery with the polarity reversed will not damage the signal generator but will subject the battery to a current drain ten times normal.

A zener diode regulates the A.C. power supply to prevent frequency changes from line voltage changes. The zener voltage is 13.0 volts, slightly higher than the battery supply voltage. As a result, the zener regulator does not consume power when operating from the battery, and the regulator will not prevent changes in the supply voltage due to bandswitching, which causes slight power supply load change. Having a battery in the mounting clip at all times will prevent the small supply voltage changes due to bandswitching.

Since the battery acts as a very effective voltage regulator when operating from the A.C. line, it is recommended that a battery be installed, even though it is not absolutely necessary if line operation only is required. No damage will result if the generator is operated without the battery.

The SG-83C power transformer is designed for operation from 50-60 Hz, but operates equally well from a line frequency of 400 Hz.

If operation is desired from 230 volts, an external autotransformer is recommended. A recommended autotransformer is the Knight 6K68HF, available from Allied Radio Corp., 100 N. Western Avenue, Chicago, Illinois 60680. If desired the

MAINTENANCE

Periodic battery replacement when necessary requires installation of a fresh NEDA 1600 battery in the mounting clip, taking care to observe the marked polarity. Inserting the battery with the polarity reversed will not damage the signal generator, but will subject the battery to a current drain ten times normal. The correct battery is:

Eveready No. 226
RCA No. VS300A
Burgess P6 or PM6

Replacement batteries should be stored in a cool place or refrigerator to obtain long shelf life. These batteries may be kept in perfect condition for years if stored near zero degrees F, producing full output after returning to room temperature.

Frequency recalibration is performed by two screwdriver adjustments on each band as shown on Figure 4. Each adjustment should be repeated several times for greatest accuracy. Frequency calibration adjustments are most conveniently made with the aid of a frequency meter such as the BC-221 or LM-series of instruments. The frequency meter should be set to the frequencies given in Figure 4. These frequency meter settings will produce clear, distinct beats.

Recalibration of the r-f output level is not likely to be required but should it become necessary it is accomplished by a screwdriver adjustment through the small hole above the bandswitch as shown in Figure 4. Set the generator for 0.1 volt output at 600 Khz as indicated on a suitable voltmeter, such as a Hewlett-Packard Model 400, Eico Model 250, or other accurate meter, connected across the output cable binding posts with the switch in the TERM position. Set the "CALIBRATE RF LEVEL" screwdriver adjustment so that the SG-83C meter reads zero db with 0.1 volts output. (This adjustment may be performed at 50 Khz instead of 600 Khz if the voltmeter used is not accurate at 600 Khz.)

The termination cable furnished with the SG-83C may be used to make convenient binding post connections to equipment under test. The termination cable has a two position slide switch marked "TERM" and "OPEN". In the "TERM" switch position, a 50 ohm resistor in the termination unit is connected across the output cable. The signal generator output in microvolts will then appear across the binding posts. The "TERM" switch position is used when the generator is connected to a *high* impedance load, such as the grid of a vacuum tube amplifier or the input of any high impedance amplifier. If the generator is connected to a 50 ohm load, or *low* impedance load such as the antenna terminals of the average communications receiver, the switch on the termination unit should be in the "OPEN" position since the receiver antenna circuit will provide the load for the signal generator.

Some signal generators are calibrated in both microvolts and dbm, or db referred to one milliwatt. One microvolt across a 50 ohm load is a level of -107 dbm. The db output scale of the SG-83C is referred to one microvolt across 50 ohms because it is less confusing to add positive db switch settings rather than negative numbers. The db readings of the SG-83C may be converted to dbm by adding -107. For example, a level of +12 db, or 4 uV, is +12 -107 or -95 dbm.

Use of a blocking capacitor in series with the output binding post is recommended to prevent accidental application of B+ from equipment under test to the signal generator output circuit and attenuator. For work above 1 Mhz, a .01 mfd blocking capacitor is suggested. Larger capacity may be desired at lower frequencies.

Calibrated levels lower than 0.6 uV are best obtained by using an external attenuator. The leakage from the SG-83C is sufficiently low that dependable tests may be made at 0.1 uV and below by this method. A suitable 20 db attenuator with BNC connectors is the type 011-0059-00 manufactured by Tektronix, Inc., Box 500, Beaverton, Oregon 97005.

Frequency stability of the SG-83C is excellent. The warm-up frequency drift so annoying in vacuum tube signal generators is completely eliminated. In normal indoor laboratory use where the temperature is rather constant, the SG-83C will hold frequency within .01% per hour. The best available vacuum tube generator will reach this stability only after several hours warm-up, if at all.

The output stage is a video amplifier which operates from 50 Khz to 54 Mhz. The gain of this amplifier has some degree of frequency dependence. An emitter peaking circuit is used to compensate for some of this frequency effect. An effect of the frequency dependent gain variation is some variation in the per cent modulation with frequency. The effect is negligible at carrier frequencies up to 30 Mhz.

THEORY OF OPERATION

The SG-83C uses a silicon, N-channel, field effect transistor oscillator to generate a carrier signal tunable from 50 Khz to 54 Mhz in six bands. The r-f field inside the shield of the oscillator is relatively weak which minimizes the external leakage field. Maximum r-f voltage across the oscillator tuned circuit is only 2.5 volts. Due to the low power level there is no warm-up frequency drift. High quality, low hygroscopic components are used, including a ceramic insulated tuning capacitor and ceramic coil forms. Stable plunger style trimmer capacitors are used. The bandswitch insulation is epoxy glass. All of these measures contribute to excellent long term and short term frequency stability. The oscillator waveform has low harmonic content because the high input impedance of the FET does not load the tuned circuit.

Output is taken from the oscillator across the tuned circuit where the waveform is most pure. A silicon transistor emitter follower stage is used, which has high input impedance, to avoid tuned circuit loading. The emitter follower stage has low output impedance and serves as a buffer between the oscillator and the following modulated amplifier.

The modulated amplifier is a silicon PNP transistor. Bias is set for nonlinear operation so that the carrier signal can be modulated by simultaneous injection of audio and r-f signals.

The r-f output voltage is measured by a special rectifier diode which has constant rectifying action over the frequency range of the generator. No d-c amplification is used in the r-f metering circuit to avoid temperature sensitivity and consequent inaccuracy of the voltmeter. The effect of temperature on the meter and diode is eliminated by a thermistor across the meter.

A screwdriver adjusted potentiometer in the modulator output circuit is used to set the r-f output voltage to the indicated level. This is a factory setting which may be easily checked and read-

generator frequency. Over the -4 db to +4 db meter scale, this frequency effect will be no more than .01% . At a fixed setting of the R-F ADJ control, the output variation across any band does not exceed 6 db.

(j) *R-F Attenuator Switches:* There are seven slide switches, each controlling a separate resistive attenuator. The output voltage of the signal generator is calibrated in db with zero db equal to one microvolt across a 50 ohm load. By using the 7 slide switches it is possible to obtain other output voltages. The output in db is the sum of the db readings from the seven switches, plus the db reading of the output meter. A chart on the front panel allows convenient conversion of the db readings to microvolts, and vice versa. The attenuator switch contacts are gold plated for long life and reliability.

(k) *R-F Output Connector:* R-F output from the generator is obtained from the R-F BNC connector. In order for the output voltage calibration to be correct, it is necessary to have a 50 ohm load on the output connector.

* * *

The SG-83C is calibrated in terms of the voltage across the 50 ohm load. This convention has been adopted by most manufacturers of standard signal generators. Some other manufacturers use a different convention, calibrating their generators in terms of the internal "constant voltage" which precedes an internal 50 ohm resistor. The output across a 50 ohm load is one-half the output indicated by these generators. This difference must be taken into account in making comparisons with the SG-83C.

So long as the output meter reading is held constant, the *open circuit* output voltage from the SG-83C will be twice the calibrated voltage across a 50 ohm load. The output meter reading will increase if all load is removed from the generator. The RF ADJ control is used to reset the meter to the original reading to maintain constant voltage.

(c) *EXT MOD Connector:* A BNC Connector is used for injecting external modulating voltage. The input impedance at this jack is 2500 ohms at 1000 Hz. One and one-half volts rms must be applied to obtain 50% modulation. Do not apply more than 10 volts to the external modulation jack to avoid possible damage to the modulation meter. Shielded coaxial cable should be used to connect the external modulating voltage since r-f leakage of several microvolts may otherwise occur from wiring to the EXT MOD connector.

(d) *METER Switch:* This switch connects the meter to read either the r-f output level, which is calibrated from -4 to +4 db, (zero db center scale) or the degree of modulation, which is calibrated in percent to 50% (full scale).

(e) *MODULATION Switch:* This switch connects the modulating circuits to the internal audio oscillator or to the external modulation jack. (The internal modulating oscillator may be modified if desired for 1000 Hz modulation. For 1000 Hz operation, capacitors C29, C31 and C32 are .015 mfd. Resistor R44 is 3.9 K.)

(f) *MOD ADJ Control:* This control is used to vary the level of internal or external modulation from zero to 50%.

(g) *BAND Switch:* The bandswitch selects the desired frequency range in six positions and 1 Mhz crystal in its seventh position. Strong harmonics of the 1 Mhz crystal output thru 54 Mhz can be obtained when desired by setting the RF ADJ control at a high output position. This overdrives the output amplifier and produces strong harmonics.

(h) *Main Tuning:* The main tuning control and dial indicate the output frequency. Tuning rate is 17% frequency change per revolution.

(i) *RF ADJ Control:* The RF ADJ control is a potentiometer which varies the r-f level and the output meter. Varying this control may cause a very slight change in the

justed if adequate test equipment is available, as described under MAINTENANCE.

The seven switches which control individual pi attenuators may be used in any combination. Each attenuator consists of three precision resistors and is accurate to within 0.1 db.

The pi connection inherently provides a stable attenuator. A shift of all three of the resistors of + 5% due to age or temperature, for example, would not change the attenuation by more than 1%. This is because the increase in the series resistance compensates for the increase in the shunt resistance. Such a resistance change, is of course, virtually impossible with the film resistors used. The actual attenuation obtained with any combination of attenuator switch settings will be within 1/4 db of the nominal attenuation.

Internal modulation is obtained from a transistor audio oscillator. This oscillator is of the phase shift type in which the primary frequency determining elements are three capacitors and three resistors. As a result of averaging the values of these six components, the frequency accuracy is within 5%. The level of the modulating voltage is controlled by the MOD ADJ panel potentiometer. The output from this potentiometer is applied to the modulator stage through a second (screwdriver adjusted) potentiometer which is factory set for 50% modulation at this indicated level. This setting may also be checked and readjusted as described under MAINTENANCE. The per cent modulation is not affected by varying the r-f output level over the calibrated range.

All circuits in the generator are designed for nominal 9 volt operation. The 9 volt potential is obtained from a full wave, well filtered supply operating from 115 volts, 50-60 hz. A 9-volt transistor battery should be installed in the battery mounting clip inside the cabinet. Although it is not essential to have the battery in place, its use is recommended since it is a very effective regulator for the supply voltage and it will prevent frequency changes due to line voltage surges. A small "trickle" charging current will flow through the battery during line voltage operation. The charging current will be greatest (approximately 2 ma) when the bandswitch is set for 1 Mhz (Xtal). The charging rate is not affected by the other controls. The charging current drops off as the battery terminal voltage rises above 9.7 volts so the battery will not overcharge. (A "9 volt" transistor battery has a terminal voltage of about 9.7 volts when new.)

When the battery is expended, its output voltage will drop and this will cause a decrease in the output indicated on the meter. As long as it is possible to set the meter to the desired db calibration line on the meter, accuracy of the output voltage is not affected by the decreased battery voltage. A depleted battery should be replaced promptly, however, to prevent corrosion of the battery clip, and preserve the voltage regulating effect of the battery.

In normal operation the generator draws 15 ma from the battery or A.C. power supply. At this drain the NEDA 1600 battery will provide about 40 hours of intermittent operation.

autotransformer may be placed inside the SG-83C cabinet. Wiring for the built-in arrangement is shown below.

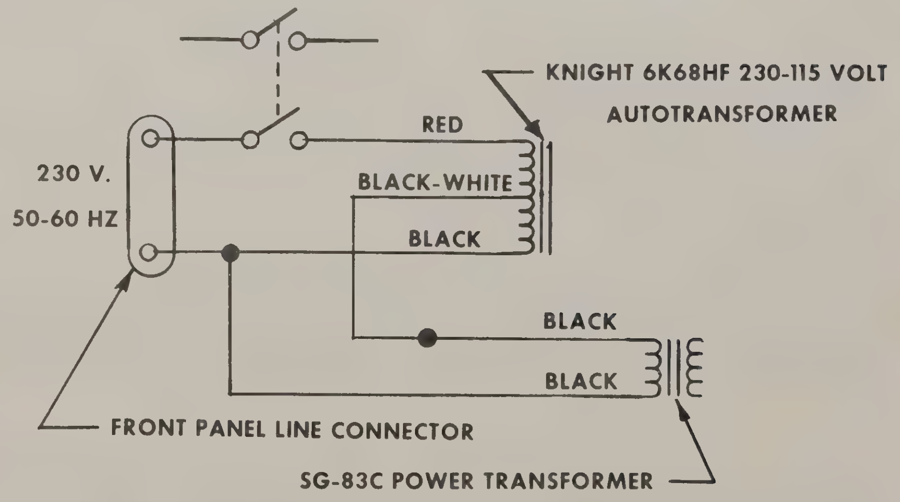

KNIGHT 6K68HF 230-115 VOLT AUTOTRANSFORMER
RED
230 V.
50-60 HZ
BLACK-WHITE
BLACK
BLACK
BLACK
FRONT PANEL LINE CONNECTOR
SG-83C POWER TRANSFORMER

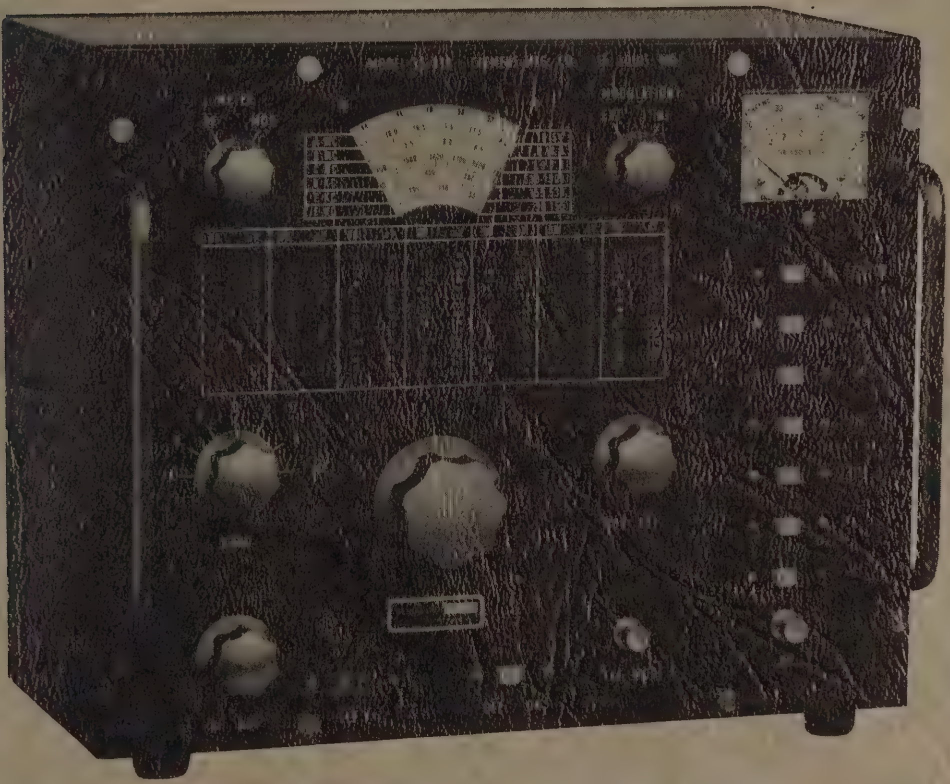
Fig. 3. Suggested Modification for 230 Volt Operation

The Model SG-83C Standard Signal Generator has the following operating controls:

(a) *OFF-ON Switch:* The power switch is a two-position slide switch which turns the generator off and on with either battery or 115 volt line operation.

(b) *115V Connector:* The line cord may be disconnected, if desired, for portable battery operation. When operating from a fresh battery, connecting the line cord will cause a slight increase in the r-f output meter reading, typically of less than one db. If there is an increase of *more* than about 2 db in the meter reading when the line cord is connected, the battery should be replaced. The battery may be left in place at all times since a small "trickle" charging current will flow into the battery during line voltage operation. The battery will not overcharge. A weak battery does not affect the accuracy of the output voltage calibration, but a depleted battery should be replaced to prevent corrosion of the battery mounting clip.

INSTRUCTIONS
for
MODEL SG-83B
Standard Signal Generator



CLEMENS MANUFACTURING COMPANY

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Printed in U.S.A.
1966
Clemens Manufacturing Company
630 South Berry Road
St. Louis, Missouri 63122
U.S.A.
Telephone: (314) 961-7228

SPECIFICATIONS

Frequency Ranges:

Band A:	18 — 54 mc
Band B:	7.0 — 18.2 mc
Band C:	1.9 — 7.0 mc
Band D:	530 — 1900 kc
Band E:	155 — 530 kc
Band F:	50 — 155 kc

Calibration: Frequency is indicated to an accuracy of 1% or better.

Output: 0.6 to 160,000 microvolts across a 50 ohm load in 1 db steps. Output is factory adjusted to 100,000 microvolts at 600 kc. The output meter and switch attenuators are accurate to within 2 db of the calibrated output at any other setting throughout the frequency range of the instrument. Leakage fields are equivalent to less than 0.2 microvolt at the output terminals.

Modulation: Amplitude modulation is variable from zero to 50%. The percent modulation is indicated on the panel meter to an accuracy of ±10%. Internal modulation is 400 cps ±5% with less than 10% distortion. Input impedance of the external modulation jack is 2500 ohms at 1000 cps. An input of 1.5 volts rms is required for 50% modulation at maximum setting of the modulation level control. Modulation is flat within 1 db from 100 cps to 5000 cps and within 3 db from 50 cps to 10,000 cps. Incidental frequency modulation is negligible below 10 mc and less than .05% at 50 mc.

Crystal Calibrator: In the seventh bandswitch position, the r-f oscillator is crystal controlled at 1 mc. Harmonics are usable to 30 mc or higher. Crystal frequency accuracy is better than .01%.

Power Supply: Operation for 40 hours, or approximately 4 months in average intermittent use of 1/2 hour per day, from NEDA 1600 9 volt transistor battery (not supplied). Alternate operation from 115 volts, 50-60 cps. Power consumption 1 watt.

Size: 10-1/2" high, 12-1/2" wide, 7-1/2" deep. Shipping weight 19 pounds. Supplied with detachable line cord, four foot output cable, heavy vinyl dust cover, and two copies of the Instruction Manual.

PRICE and DELIVERY

The SG-83B Standard Signal Generator, with output and power cables, vinyl dust cover, and two copies of the Instruction Manual . . . . .$295.00 f.o.b. St. Louis. Immediate shipment from stock.

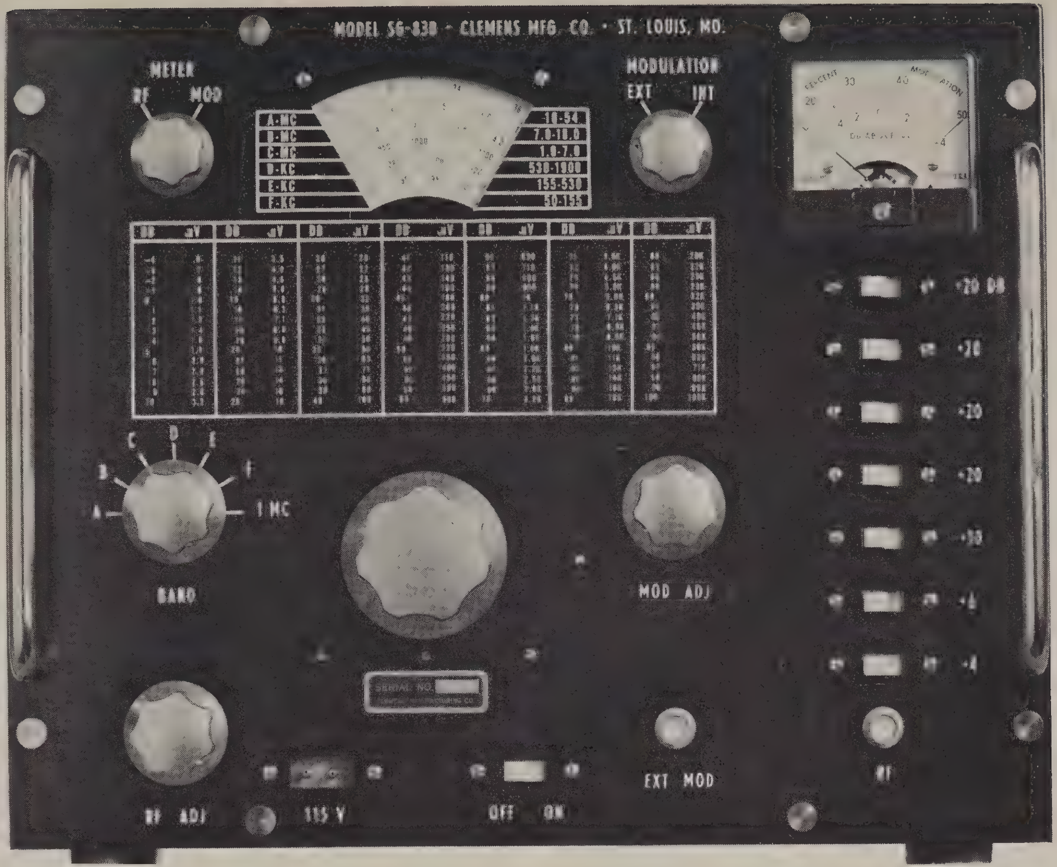


Figure 1 Model SG-83B
Standard Signal Generator

STANDARD SIGNAL GENERATOR
MODEL SG-83B

DESCRIPTION

The first all solid-state Standard Signal Generator, with output accurately calibrated in microvolts, was the Model SG-83 introduced by Clemens Manufacturing in 1962 and now in use throughout the world. This model was followed by an improved design, the Model SG-83A, introduced in 1964.

Comments from many users were evaluated in continuing development which has culminated in the Model SG-83B. The Model SG-83B has mechanical and circuit improvements which result in wider tolerance on battery voltage, and elimination of small r-f and modulation level changes due to switching. Output level variations with frequency have been smoothed and reduced, and the accuracy of the per cent modulation and r-f level metering is improved.

The low cost SG-83B has many desirable features in common with the most expensive standard signal generators. Standard signal generators from Clemens Manufacturing are in use in the largest industrial, university, and U.S. Government laboratories. Those engaged in communications circuit development will find the SG-83B indispensable. The low cost and stability of the SG-83B also make it ideal for production line alignment stations.

SG-83B PERFORMANCE FEATURES

- 50 kc to 54 mc Coverage, 1% Frequency Calibration
- Output Calibrated 0.6 Microvolt to 160,000 Microvolts (.16 volt)
- 1 mc Crystal Operation
- Per Cent Modulation Variable 0 to 50% (Indicated on Meter)
- External Modulation Connector
- Operates from Internal Battery or from 115 Volts 50-60 cps
- BNC Connectors

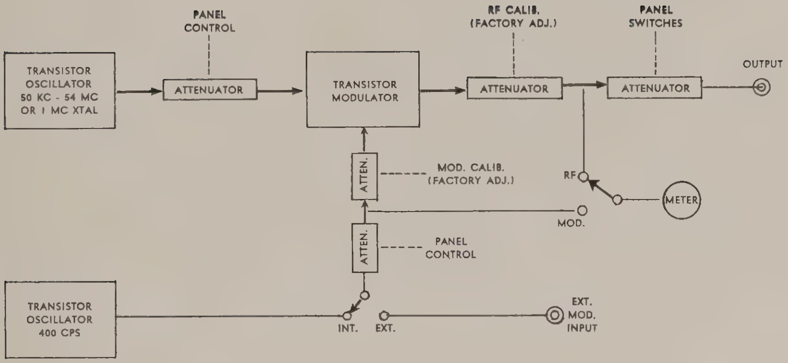


Figure 2 Block Diagram

The SG-83B consists of a transistor oscillator followed by a modulated amplifier whose output is metered and attenuated. A transistor audio oscillator produces the modulating signal. Careful filtering and shielding prevent signal leakage.

The r-f output voltage level is indicated on the output meter. The metered r-f voltage is applied to an attenuator which consists of seven switches, each controlling a pi resistive attenuator. The switch attenuator is preferred to the waveguide type in applications up to 100 mc because the minimum insertion loss is zero. The reset accuracy of a switch attenuator is superior since there is no parallax or backlash. Through combinations of the switches, the attenuation may be set to any desired value in increments of 4 db or more. Changes in level of less than 4 db are obtained by varying the setting of the output meter, which is calibrated in one db increments from -4 to +4 db.

Output calibration is in db with zero db equal to one microvolt across a 50 ohm load. Levels up to 160,000 microvolts (+104 db) or down to 0.6 microvolt (-4 db) are obtainable using the switch attenuator and meter. Accuracy of the output voltage is typically within 1 db. Maximum calibrated output of the SG-83B is 160,000 microvolts into a 50 ohm load, or twice this level when driving an open circuit.

A chart on the face of the instrument permits rapid conversion of the db readings into microvolts, and vice versa. For greater convenience the lines of the chart are offset every 5 db.

Frequency range of the SG-83B is continuous from 50 kc to 54 mc. The range is covered in 6 bands with an average dial scale length of 12 inches on each band. A non-microphonic ceramic insulated tuning capacitor is used to maintain accurate dial calibration and all frequency determining components are of premium quality. Coil forms are ceramic. The SG-83B dial is easily recalibrated since all calibration adjustments are accessible through the front panel without removing the cabinet or disturbing the shielding. A seventh position on the bandswitch converts the oscillator to 1 mc crystal control.

The dial in the SG-83B is driven by a smooth, rim drive, all metal vernier mechanism. The frequency calibration is permanently printed on a metal dial which is gear driven by the tuning capacitor. A hairline dial index very close to the dial for low parallax, results in a dial of high resolution, readability and reset accuracy. Dial calibration is accurate to 1% or better on all ranges. Each generator is individually calibrated by adjustment of slotted plates on the tuning capacitor.

Output from the transistor oscillator is applied to a variable attenuator which is adjusted by a front panel control to set the output meter at the desired level. Following this attenuator is the modulated output amplifier transistor. There is a negligible change in oscillator frequency as the attenuator is varied to set the output meter at the desired level. Since the oscillator is not modulated, incidental frequency modulation is prevented and an excellent modulation envelope is obtained.

The meter may be switched to read either r-f output level, or percent modulation. Modulation level is continuously variable from zero to 50%. A second switch selects either internal 400 cps sinusoidal modulation, or the BNC front panel connector labelled "EXT MOD." The modulation meter and level control are effective in controlling and measuring the voltage applied to the external modulation BNC connector, as well as the internal modulation signal.

The SG-83B may be operated from a battery carried inside the cabinet, or from the built-in power supply which operates from 115 volts, 50-60 cps. When operating from the internal battery, the line cord may be detached from the cabinet for convenience. With line cord operation, the amount of A.C. power consumed is negligible and is not sufficient to heat the cabinet. There is, of course, no warm-up frequency drift, so that the battery may be conserved by switching the generator off between tests. A standard, inexpensive, 9-volt transistor battery is used, available at radio, drug, or hardware stores. The battery mounts in a clip and may be easily changed without tools by removing only the outer cabinet thumbscrews.

An output cable with binding posts, terminating resistor and switch is supplied. The switch permits the terminating resistor to be removed whenever the equipment under test presents a terminating load for the cable. A detachable line cord is also furnished, plus a heavy-gauge, clear vinyl dust jacket for the generator.

APPLICATIONS

The SG-83B is ideal for:

- Crystal and mechanical filter response curves — r-f, mixer, and i-f amplifier gain, bandwidth, regeneration, measurements
- Image rejection tests
- Signal to noise ratio tests
- Comparison of antennas and beam antenna front/back ratio
- S-Meter calibration
- Production alignment of communications equipment
- Field servicing of jungle, mobile and aeronautical radios
- Repair of delicate transient susceptible transistor radios

OPERATION

The Model SG-83B Standard Signal Generator may be operated from either battery or the 115 volt A.C. line. The generator is shipped without the battery. A 9-volt transistor battery (NEDA type 1600; Eveready No. 226, RCA No. VS300A, Burgess P6 or PM6) should be installed when the generator is received. This is done by removing the knurled thumbscrews which secure the front panel to the outer cabinet. The battery may then be snapped into the mounting clip, taking care to observe the polarity marking. Inserting the battery with the polarity reversed will not damage the signal generator but will subject the battery to a current drain five times normal.

Since the battery acts as a very effective voltage regulator when operating from the A.C. line, it is recommended that a battery be installed, even though it is not absolutely necessary if line operation only is required. No damage will result if the generator is operated without the battery.

The SG-83B power transformer is designed for operation from 50-60 cps, but operates equally well from a line frequency of 400 cps. Because of the very small power consumption, it is perfectly practical to operate the generator from a 230 volt, 50-60 cps line through the use of a dropping resistor in one leg of the power line. A 10,000 ohm resistor (2 watts or more) is satisfactory.

The Model SG-83B Standard Signal Generator has the following operating controls:

(a) OFF-ON Switch: The power switch is a two-position slide switch which turns the generator off and on with either battery or 115 volt line operation.

(b) 115 V Connector: The line cord may be disconnected, if desired, for portable battery operation. When operating from a fresh battery, connecting the line cord will cause a slight increase in the r-f output meter reading, typically of less than one db. If there is an increase of more than about

2 db in the meter reading when the line cord is connected, the battery should be replaced. The battery may be left in place at all times since a small "trickle" charging current will flow into the battery during line voltage operation. The battery will not overcharge. A weak battery does not affect the accuracy of the output voltage calibration, but a depleted battery should be replaced to prevent corrosion of the battery mounting clip.

(c) EXT MOD Connector: A BNC Connector is used for injecting external modulating voltage. The input impedance at this jack is 2500 ohms at 1000 cps. One and one-half volts rms must be applied to obtain 50% modulation. Do not apply more than 10 volts to the external modulation jack to avoid possible damage to the modulation meter. Shielded coaxial cable should be used to connect the external modulating voltage since r-f leakage of several microvolts may otherwise occur from the EXT MOD connector.

(d) METER Switch: This switch connects the meter to read either the r-f output level, which is calibrated from -4 db to +4 db, (zero db center scale) or the degree of modulation, which is calibrated in percent to 50% (full scale).

(e) MODULATION Switch: This switch connects the modulating circuits to the internal audio oscillator or to the external modulation jack. The internal modulating oscillator may be modified if desired for 1000 cps modulation. For 1000 cps operation, capacitors C29, C31 and C32 are .015 mfd. Resistor R44 is 3.9 K.

(f) MOD ADJ Control: This control is used to vary the level of internal or external modulation from zero to 50%.

(g) BAND Switch: The bandswitch selects the desired frequency range in six positions and a 1 mc crystal in its seventh position.

(h) Main Tuning: The main tuning control and dial indicate the output frequency.

(i) RF ADJ Control: The RF ADJ control is a potentiometer which varies the r-f level on the output meter. Varying this control may cause a very slight change in the generator frequency. Over the -4 db to +4 db meter scale, this frequency effect will be no more than about .01% thru 18 mc and no more than 0.1% at 50 mc. At a fixed setting of the R-F ADJ control, the output variation across any band does not exceed 6 db.

(j) R-F Attenuator Switches: There are seven slide switches, each controlling a separate resistive attenuator. The output voltage of the signal generator is calibrated in db with zero db equal to one microvolt across a 50 ohm load. By using the 7 slide switches it is possible to obtain other output voltages. The output in db is the sum of the db readings from the seven switches, plus the db reading of the output meter. A chart on the front panel allows convenient conversion of the db readings to microvolts, and vice versa.

(k) R-F Output Connector: R-F output from the generator is obtained from the R-F BNC connector. In order for the output voltage calibration to be correct, it is necessary to have a 50 ohm load on the output connector.

* * *

The SG-83B is calibrated in terms of the voltage across the 50 ohm load. This convention has been adopted by most manufacturers of standard signal generators. Some other manufacturers use a different convention, calibrating their generators in terms of the internal "constant voltage" which precedes an internal 50 ohm resistor. The output across a 50 ohm load is one-half the output indicated by these generators. This difference must be taken into account in making comparisons with the SG-83B.

So long as the output meter reading is held constant, the open circuit output voltage from the SG-83B will be twice the calibrated voltage across a 50 ohm load. The output meter reading will increase if all load is removed from the generator. The RF ADJ control is used to reset the meter to the original reading to maintain constant voltage.

The termination cable furnished with the SG-83B may be used to make convenient binding post connections to equipment under test. The termination cable has a two position slide switch marked "TERM" and "OPEN". In the "TERM" switch position, a 50 ohm resistor in the termination unit is connected across the output cable. The signal generator output in microvolts will then appear across the binding posts. The "TERM" switch position is used when the generator is connected to a high impedance load, such as the grid of a vacuum tube amplifier or the input of any high impedance amplifier. If the generator is connected to a 50 ohm load, or low impedance load such as the antenna terminals of the average communications receiver, the switch on the termination unit should be in the "OPEN" position since the receiver antenna circuit will provide the load for the signal generator.

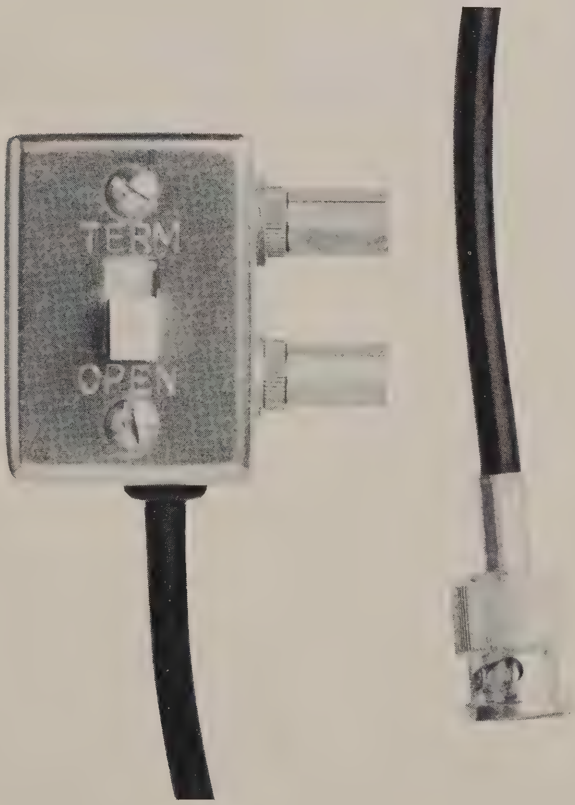


Figure 3 Output Termination Cable

Some signal generators are calibrated in both microvolts and dbm, or db referred to one milliwatt. One microvolt across a 50 ohm load is a level of -107 dbm. The db output scale of the SG-83B is referred to one microvolt across 50 ohms because it is less confusing to add positive db switch settings rather than negative numbers. The db readings of the SG-83B may be converted to dbm by adding -107. For example, a level of +12 db, or 4 uV, is +12 -107 or -95 dbm.

Use of a blocking capacitor in series with the output binding post is recommended to prevent accidental application of B+ from equipment under test to the signal generator output circuit and attenuator. For work above 1 mc, a .01 mfd blocking capacitor is suggested. Larger capacity may be desired at lower frequencies.

Harmonic output of the SG-83B may be used to obtain frequencies above 54 mc without calibrated output voltages. The second harmonic will be about 20 db below the fundamental frequency output.

Calibrated levels lower than 0.6 uV are best obtained by using an external attenuator. The leakage from the SG-83B is sufficiently low that dependable tests may be made at 0.1 uV and below by this method.

THEORY OF OPERATION

The SG-83B r-f oscillator uses a high frequency transistor to generate a signal tunable from 50 kc to 54 mc in six bands. The r-f power level is low which minimizes external leakage fields. Also, as a result of the low power level, warm-up drift is eliminated. To further enhance the stability, a low microphonic tuning capacitor and ceramic coil forms are used. Stable plunger style trimmer capacitors are used.

On the lower frequency bands the impedance across the oscillator tuned circuit is much higher than the impedance represented by the transistor. It is necessary to tap the transistor across only a portion of the tuned circuit to maintain high tank circuit Q. This requires a tapped inductance having parasitic resonances other than the desired frequency. R, L, and C networks in the leads between the oscillator transistor and the tuned circuit prevent oscillation at these undesired frequencies. On band E a diode is included in the network to improve oscillator waveform.

The output of the oscillator is modulated by a second high frequency transistor which is operated as a Van der Bijl modulater, that is, an amplifier which is biased for operation in a region where there is substantial curvature of the transfer characteristic. The modulator uses the common emitter circuit in order to minimize the loading effect on the oscillator. Output at the modulator collector is read with the r-f output metering circuit. No tuned circuits are used in the modulator and as a result there is no discrimination against sidebands, even with 10 kc modulation of a 50 kc carrier.

A screwdriver adjusted potentiometer in the modulator output circuit is used to set the r-f output voltage to the indicated level. This is a factory setting which may be easily checked and readjusted if adequate test equipment is available, as described under MAINTENANCE.

The seven switches which control individual pi attenuators may be used in any combination. Each attenuator consists of three 5% resistors. The average accuracy of each attenuator is 2%.

The pi connection inherently provides a stable attenuator. A shift of all three of the resistors of +5% due to age or temperature, for example, would not change the attenuation by more than 1%. This is because the increase in the series resistance compensates for the increase in the shunt resistance.

An error analysis based on measurement of 80 attenuators predicts a 99% probability that the actual attenuation obtained with any combination of attenuator switch settings will be within 1 db of the nominal attenuation.

Internal modulation is obtained from a transistor audio oscillator. This oscillator is of the phase shift type in which the primary frequency determining elements are three capacitors and three resistors. As a result of averaging the values of these six components, the frequency accuracy is within 5%. The level of the modulating voltage is controlled by the MOD ADJ panel potentiometer. The output from this potentiometer is applied to the modulator stage through a second (screwdriver adjusted) potentiometer which is factory set for 50% modulation at this indicated level. This setting may also be checked and readjusted as described under MAINTENANCE. The percent modulation is not affected by varying the r-f output level over the calibrated range.

The meter uses a half wave, peak reading, diode rectifier to measure the r-f output level. The modulation metering circuit uses a full wave, average reading, bridge rectifier to prevent clipping or distortion of the modulating waveform. With an external modulating signal, the depth of modulation drops off at modulating frequencies below 100 cps. This is due to emitter degeneration in Q2. The response of the full wave rectifier circuit to low frequencies is determined by the value of C30 which has been designed so that the indicated per cent modulation on the meter matches the true per cent modulation of the carrier down to 30 cps.

All circuits in the generator are designed for 9 volt operation. The 9 volt potential is obtained from a full wave, well filtered supply operating from 115 volts, 50-60 cps. A 9-volt transistor battery should be installed in the battery mounting clip inside the cabinet. Although it is not essential to have the battery in place, its use is recommended since it is a very effective regulator for the supply voltage and it will prevent frequency changes due to line voltage surges. A small "trickle" charging current will flow through the battery during line voltage operation. The charging current will be greatest (approximately 2-1/2 ma) when the bandswitch is set for 1 mc (Xtal). The charging rate is not affected by the other controls. The charging current drops off as the battery terminal voltage rises above 9 volts so the battery will not overcharge.

When the battery is expended, its output voltage will drop and this will cause a decrease in the output indicated on the meter. As long as it is possible to set the meter to the desired db calibration line on the meter, accuracy of the output voltage is not affected by the decreased battery voltage. A depleted battery should be replaced promptly, however, to prevent corrosion of the battery clip, and preserve the voltage regulating effect of the battery.

In normal operation the generator draws 8 to 13 ma from the battery or A.C. power supply. At this drain the NEDA 1600 battery will provide about 40 hours of intermittent operation.

MAINTENANCE

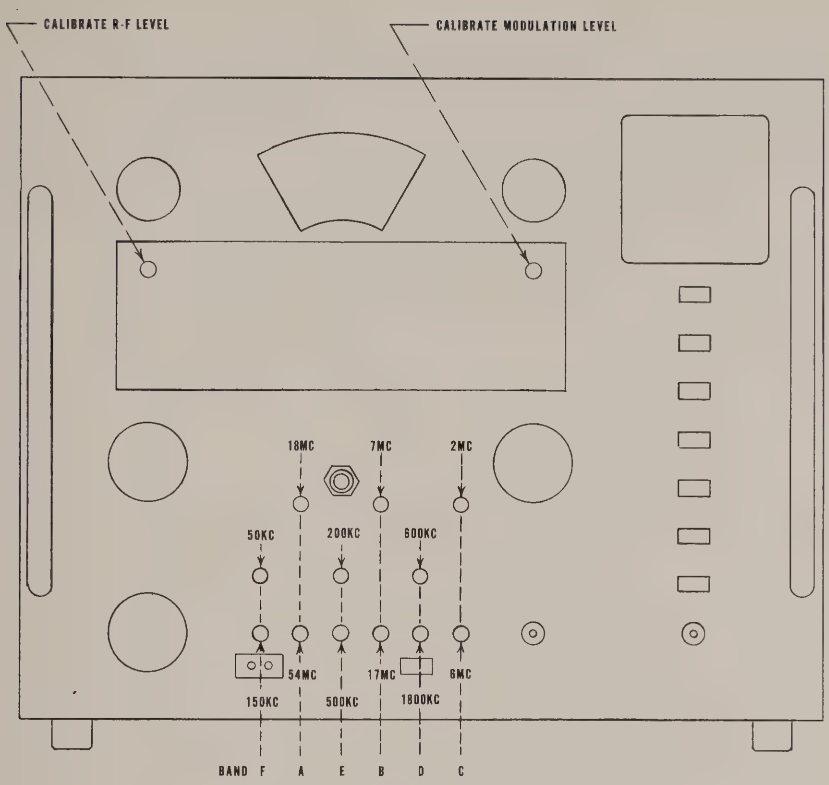
Periodic battery replacement when necessary requires installation of a fresh NEDA 1600 battery in the mounting clip, taking care to observe the marked polarity. Inserting the battery with the polarity reversed will not damage the signal generator, but will subject the battery to a current drain five times normal. The correct battery is:

Eveready No. 226
RCA No. VS300A
Burgess P6 or PM6

Replacement batteries should be stored in a cool place or refrigerator to obtain long shelf life. These batteries may be kept in perfect condition for years if stored near zero degrees F, producing full output after returning to room temperature.

Frequency recalibration is performed by two screwdriver adjustments on each band as shown on Figure 4. Each adjustment should be repeated several times for greatest accuracy. Frequency calibration adjustments are most conveniently made with the aid of a frequency meter such as the BC-221 or LM- series of instruments. The frequency meter should be set to the frequencies given in Figure 4. These frequency meter settings will produce clear, distinct beats. The calibration adjustments should be made with the r-f output meter reading within its calibrated range rather than pegged at full scale, for greatest calibration accuracy.

Recalibration of the r-f output level is not likely to be required but should it become necessary it is accomplished by a screwdriver adjustment through the small hole above the bandswitch as shown in Figure 4. Set the generator for 0.1 volt output at 600 kc as indicated on a suitable voltmeter, such as a Hewlett-Packard Model 400, Eico Model 250, or other accurate meter, connected across the output cable binding posts with the switch in the TERM position. Set the "CALIBRATE RF LEVEL" screwdriver adjustment so that the SG-83B meter reads zero db with 0.1 volts output. (This adjustment may be performed at 50 kc instead of 600 kc if the voltmeter used is not accurate at 600 kc.)



REMOVE MAIN TUNING KNOB FOR ACCESS TO ADJUSTMENTS

SG83B Band	BC221 Frequency	Alignment Low Frequency	Alignment High Frequency
A	3.000 mc	18 mc	54 mc
B	1.000 mc (Xtal)	7 mc	17 mc
C	1.000 mc (Xtal)	2.0 mc	6.0 mc
D	200 kc	600 kc	1800 kc
E	200 kc	200 kc	500 kc
F	200 kc	50 kc	150 kc

Figure 4 Model SG-83B Alignment Adjustments

Readjustment of the modulation per cent is accomplished by a screwdriver adjustment through the small hole above the MOD ADJ control. The modulation pattern, Fig. 5, should be obtained on an oscilloscope connected across a 50 ohm termination on the generator. Modulation per cent should also be set with a level of 0.1 volts at 600 kc (or 50 kc if oscilloscope bandwidth is limited). With the meter indicating 50% modulation adjust the "CALIBRATE MODULATION LEVEL" screwdriver setting until B/A = 3/1 in Figure 5. If desired, the modulation may be calibrated at the 30% point on the meter. For 30% modulation, B/A= 1.86.

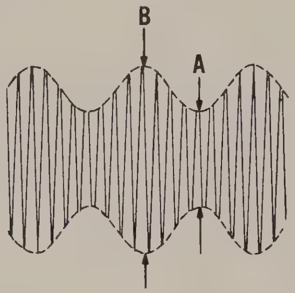


Figure 5 Modulation Envelope

Other percentages of modulation may be computed from the relationship:

$$\text{Per Cent Modulation} = 100 \times \frac{B - A}{B + A}$$

Although transistors have outstanding advantages in making practical battery operation and in elimination of warm-up drift, the transistor is inherently less tolerant than a vacuum tube to voltage transients. For this reason use of a blocking capacitor in series with the output binding post is recommended in routine work. This will prevent damage to the switch attenuator and output transistor in the event there is accidental contact with the B+ from the equipment under test. For work at 1 mc and above, a .01 mfd capacitor is suggested. For lower frequencies, higher capacity may be preferred. It is also possible to destroy the output transitor if a transciever under test is accidentally turned to transmit while connected to the SG-83B. The switch attenuator can withstand the steady application of up to 6 volts D.C. or rms without damage.

Field replacement of transistors is not difficult and will not invalidate the microvolt calibration of the SG-83B. It is not necessary to return the generator to the factory. The shielded switch attenuator need not be disturbed. Only the shield over the generator assembly is removed, by removal of sixteen screws.

If the audio oscillator transistor, Q3 (type 2N508) is damaged, it can be replaced without affecting the modulation frequency, per cent, or waveform.

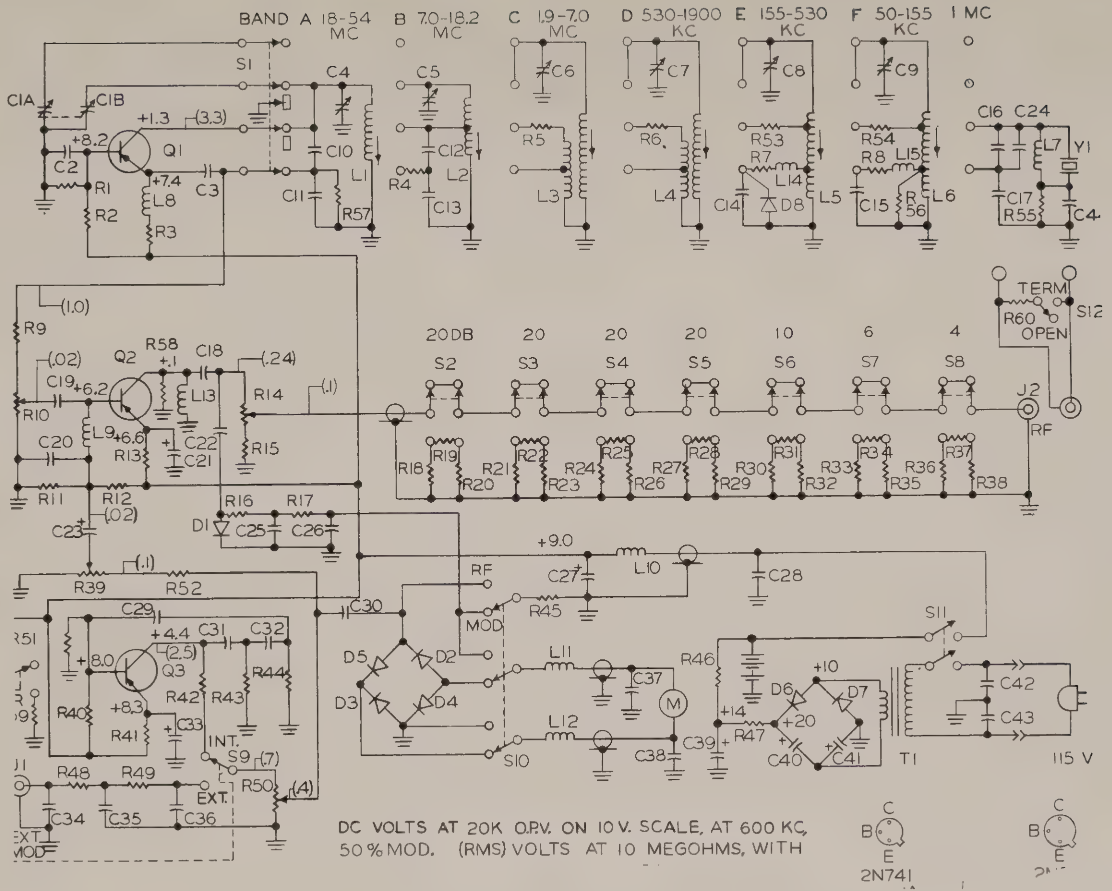
If the r-f output transistor, Q2 (type 2N741A) is damaged, it can be replaced without affecting the microvolt calibration in any way. The per cent modulation will require recalibration with an oscilloscope, as described above.

The oscillator transistor, Q1, (type 2N741) can be replaced also without affecting the microvolt calibration. Replacement may cause a slight change in the frequency calibration, although usually the change will not exceed the 1% calibration tolerance. If the frequency dial calibration error is excessive after oscillator transistor replacement, the dial may be recalibrated with a frequency meter as described above.

Correct D.C. voltages are shown on the schematic diagram at a number of circuit points as an aid to troubleshooting. All D.C. voltages under 10 volts are read on the 10 volt scale of a 20,000 ohms per volt meter. R-F and audio frequency voltages are also shown in parentheses. These are read with an A.C. meter such as the Hewlett Packard 400 or Eico 250.

PARTS LIST

C1 10-272 pf 2-gang variable
C2 .1 mfd ± 10% mylar
C3, C18, C20, C25, C26, C28, C35, C36, C44 .01 mfd ± 10% ceramic
C4, C5, C6, C7, C8, C9 1-8 pf variable
C10 15 pf ± 5% mica
C11, C12 100 pf ± 5% mica
C13, C14 360 pf ± 5% mica
C15 .0022 mfd ± 10% mylar
C16 150 pf ± 5% mica
C17, C34, C37, C38 .001 mfd ± 10% mylar
C19, C22, C29, C31, C32 .047 mfd ± 10% mylar
C21, C23, C27, C33, C39, C40, C41 100 mfd 16 volt electrolytic
C24 33 pf ± 5% mica
C30 .47 mfd ± 10% mylar
C42, C43 .0047 mfd GMV 1400 volt ceramic
D1, D2, D3, D4, D5, D6, D7, D8 1N34A
L1 .17 uh
L2 1.7 uh
L3 13 uh
L4 160 uh
L5 1.7 mh
L6 19 mh
L7, L8, L10, L11, L12 250 uh
L9, L13 1.5 mh
L14, L15 100 uh
M 50 ua
Q1 2N741
Q2 2N741A
Q3 2N508
(All fixed resistors 1/2W., ± 5%)
R1, R11 10 K ohms
R2, R16, R17, R42, R52, R55, R56 2.2 K ohms
R3, R6, R13, R15, R41, R47 470 ohms
R4, R18, R20, R21, R23, R24, R26, R27, R29 62 ohms
R5, R19, R22, R25, R28 240 ohms
R7, R8, R46, R57 390 ohms
R9, R30, R32 100 ohms
R10, R50 1 K ohms, log taper variable
R12, R45 4.7 K ohms
R14 100 ohms linear taper variable
R31 68 ohms
R33, R35 150 ohms
R34 39 ohms
R36, R38 220 ohms
R37 22 ohms
R39 1 K ohms, linear taper variable
R40, R44 2.7 K ohms
R43 3.9 K ohms
R48, R49, R53, R54, R58 1 K ohms
R51 27 K ohms
R59 6.2 K ohms
R60 51 ohms
T1 Pri., 115 V. 50-60 cps. Sec., 6V
Y1 1.000 mc



DC VOLTS AT 20K O.P.V. ON 10 V. SCALE, AT 600 KC, 50 % MOD. (RMS) VOLTS AT 10 MEGOHMS, WITH

Figure 6 Model SG-83B Schematic Diagram

APPENDIX

RECEIVER MEASUREMENT PROCEDURES

The most frequently made receiver measurements for which a standard signal generator is required are the: (1) Signal-Plus-Noise-to-Noise Ratio, (2) Response Curve, and (3) Image and Spurious Response Rejection. A description of the measurement technique for each follows.

1. Signal-Plus-Noise-to-Noise Ratio measures the ability of a receiver to extract the modulation from a weak signal. The receiver is operated in the normal condition for reception of amplitude modulation. An output voltmeter is connected across the audio output terminals or loudspeaker. The audio gain control is set for a convenient reading near full scale on the output meter, from a strong signal, modulated 30% by 400 cycles, from the signal generator. The signal generator is operated with the termination cable in the "OPEN" condition, since the receiver antenna circuit will terminate the signal generator. The output of the signal generator is then decreased gradually while the modulation is switched on and off, until there is a 10 db increase in receiver output with modulation over the receiver output from the unmodulated signal. The r-f level where this condition is obtained is the 10 db S+N/N sensitivity in microvolts.

2. Response Curves are usually measured at the i-f frequencies of the receiver since the selectivity of r-f amplifiers or other tuned circuits has little influence on the shape of the curve. Elements which may result in non-linearity in the receiver must be eliminated to obtain a valid measurement. For this reason, the AVC circuit is usually shorted or disabled and the second detector is operated at a constant level for all measurements. The response curve should be made using the lowest possible signal levels which will override noise because selective circuits are usually distributed between amplifier stages and care must be observed in preventing overload of any stage of the amplifier. A modulated signal and audio output meter may be used conveniently when measuring response

curves in which the bandwidth is several kilocycles, but for very narrow response curves of 1 kilocycle or less in width, an unmodulated signal is necessary to avoid discrimination against the sidebands. A vacuum tube voltmeter is used, with the unmodulated signal, and the dc voltage across the second detector load resistor is used as an output indicator.

Either the DC voltage across the second detector load resistor or the audio output voltage should be maintained constant as the input frequency and input level from the signal generator are varied. In this way the response curve can be measured over a 60 to 80 db range.

3. Image or Spurious Frequency Rejection is measured with the same requirements which apply to response curves, i.e., the reference level at the frequency to which the receiver is tuned should be held constant, and should be the lowest level capable of producing an easily discernible output. The AVC should also be disabled. After obtaining a reference sensitivity or input for standard output at the receiver frequency, the signal generator should be tuned to the image frequency and the signal generator output increased until the same standard output level is obtained from the receiver. Image rejection is then the ratio of the signal generator level at the image frequency to the level at the receiver frequency for constant output. Other spurious responses are measured in a similar way, operating the signal generator at high output level as it is tuned over its complete range and then adjusting to the standard output for measurement of the spurious rejection ratio. Responses due to harmonic output from the signal generator are disregarded.

NOTES

WARRANTY

Repair or replacement of any defective part within ninety days after purchase will be made provided the unit is delivered with transportation charges prepaid to the factory and provided the unit has not been subjected to misuse. This warranty is in lieu of all other warranties expressed or implied.

MULTIPLIER PREFIXES

Prefix	Abbreviation*	Multiplier
tera	T	10^{12}
giga	G	10^{9}
mega	M	10^{6}
kilo	k	10^{3}
deci	d	10^{-1}
centi	c	10^{-2}
milli	m	10^{-3}
micro	u	10^{-6}
nano	n	10^{-9}
pico	p	10^{-12}

*Although the abbreviations shown are recommended, almost all technical publications deviate to use upper or lower case letters for consistency in style or to conform to common usage.

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